

# MODULE 1: LAYING THE GROUNDWORK

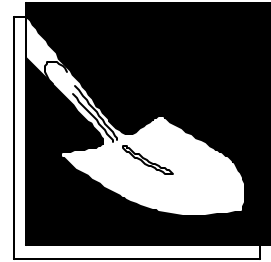
This module contains an overview of Environmental Management Systems, suggestions for how to build internal support for your IEMS, ideas for developing your IEMS management team, and a process for understanding how your company impacts the environment.

## Overview of Environmental Management Systems

An **Environmental Management System** (EMS) provides a systematic way to review and improve operations for better **environmental performance**. An EMS can help a company better meet its compliance requirements. It can also help a company use materials more efficiently and streamline operations, thereby reducing costs and becoming more competitive.

A commonly used framework for an EMS is the one developed by the International Organization for Standardization (ISO) for the ISO 14001 standard. *Although the EMS described in this Guide is based on the ISO 14001 approach, the process outlined in this Guide may not provide for meeting all the requirements of ISO 14001 certification.* The purpose of this Guide is not to give advice towards certification. It is to demonstrate a technical means of integrating environmental concerns into company management so that businesses can become more effective in reducing their impact on the environment.

In addition, other guides on the market provide useful



### Tip

An **EMS** is a framework for managing those significant **environmental aspects** you can control or influence.

### Tip

Words in **bold type** can be found in the Glossary (Appendix A).

approaches. Developing an IEMS based on this Guide does not imply endorsement by the U.S. EPA.

The five main stages of an EMS, as defined by the ISO 14001 standard, are as follows.

- < *Commitment and policy* — top management commits to environmental improvement and establishes a company **environmental policy**.
- < *Planning* — the company conducts a review of its operations, identifies legal requirements and environmental concerns, establishes objectives, evaluates alternatives, sets targets, and devises a plan for meeting those targets.
- < *Implementation* — the company follows through with the plan by establishing responsibilities, training, communication, documentation, operating control procedures, and an emergency plan to ensure that **environmental targets** are met.
- < *Evaluation* — the company monitors its operations to evaluate whether the targets are being met, and, if not, takes **corrective action**.
- < *Review* — the EMS is modified to optimize its effectiveness. The review stage creates a loop of continuous improvement for the company (Figure 1-a).

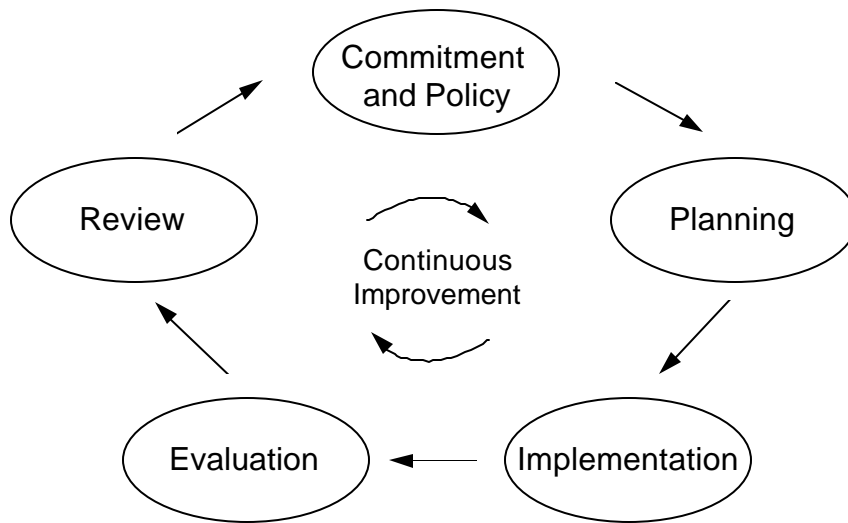
### **L Tip**

For more information on ISO 14001 EMS, check Appendix G (References and Resources).

### **L Tip**

Continuously identifying and reducing risk leads to improved competitiveness and environmental performance.

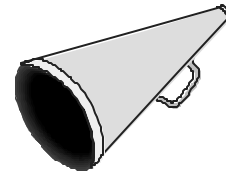
Figure 1-a. The Continuous Improvement Cycle



The advantage of adopting the DfE Program approach is that it enables your company to consider and plan for managing the environmental risk of your company's products, processes and services. The method outlined in this Guide will help your company compare alternatives to identify the least cost, best performing and lowest environmental impact option. This approach will help your company do the following:

- < practice pollution prevention,
- < use resources efficiently,
- < avoid shifting problems from one waste stream to another,
- < understand the risks associated with using both regulated and unregulated chemicals,
- < integrate management of worker safety and health requirements with management of environmental concerns, practice extended product and process responsibility, and
- < manage system change in addressing environmental concerns.

Thus, by using the approach provided in this Guide, you can develop a IEMS that helps you continuously identify and reduce risks to people and the environment. This Guide provides methods



**Screenprinters from the SGIA/EPA IEMS Pilot Project have this to say about what they learned:**

"That you can have a system to achieve environmental improvement. Never gave it much thought before."

"Changed from being reactive to environmental regulations to being more proactive."

"The benefits of having documented operational controls."

"General environmental awareness building across the board; and that you can be bottom-line oriented and environmentally conscious at the same time."

"That the ultimate benefit is improving the environment and improving the bottom line at the same time."

to help you consider risk reduction when answering the following questions.

- < How does your company impact the environment?
- < Which of these environmental impacts are significant?
- < How can your company improve its environmental performance?

## Building Support for Your IEMS

Both management and employees need to understand not only what a IEMS is, but also why they would want one. This step is designed to get people to think about and discuss the ways in which a IEMS would benefit your company. Even though you may already have management support, it is still important to get employee buy-in to this process.

Set up times to discuss your company's need for a IEMS with key managers and employees. Recording the discussions provides important documentation, which can be used to communicate the benefits of your IEMS to others. One way to record the discussion is to assign someone the task of writing the group's comments on a flip chart, so that everyone can see them for discussion. The following set of general questions will lead you through the discussion.

### Discussion Questions

1. Which environmental and worker safety laws and regulations is your company required to follow?
2. How does your company define environmental performance?
3. Does lack of time or resources prevent your organization from taking charge of its environmental obligations? Are



Through years of working with companies, the DfE Program has learned the importance of building support from participants through open and frequent discussion about mutual concerns.

there individuals appointed to be responsible for this function?

4. What is your company's environmental policy?
5. Does your organization know how its environmental objectives relate to its business objectives?<sup>1</sup>

To build support, consider the benefits a IEMS might provide for your company. A more systematic approach to meeting your environmental and business goals might contribute to the following in your company:

- < improved environmental performance
- < improved worker health and safety
- < improved competitiveness
- < improved compliance and reduced liability
- < fewer accidents
- < lower insurance premiums
- < improved public image
- < enhanced customer trust
- < better access to capital
- < improved internal communication
- < improved company morale
- < reduced operating costs

It will be helpful at this point to create a worksheet comparing the expected costs and benefits of developing a IEMS. Worksheet 1-1 provides some general categories of costs and benefits. When making your comparison, provide specific examples from the discussion.

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1

Adapted from: *Environmental Management Systems: An Implementation Guide for Small and Medium-Sized Organizations*. Ann Arbor, MI: NSF International, November 1996, p.3.

### **L Tip**

To help get facility-wide buy-in to the IEMS process, find the workers who are most enthusiastic with the process and recruit them to spread the word among their peers. Commitment from top management is essential, but you also need promoters at all levels of your company.

## Assigning Responsible Persons

Designate, as soon as possible, the Management Representative, the IEMS Coordinator, and a Committee who will be responsible for promoting and developing your IEMS. If you have a very small company, these may all be the same person! However, it is still important to designate who will be responsible for various activities. Worksheet 1-2 provides a means to document the responsible persons. This worksheet can be placed in your Company IEMS Manual (see the *Company Manual Template*).

## Worksheet 1-1: Costs and Benefits of Developing and Implementing an IEMS<sup>2</sup>

| Costs   | Benefits   |
|---|--|
| <ul style="list-style-type: none"> <li>&lt; Staff/employee time for: <ul style="list-style-type: none"> <li>collecting information</li> <li>reading and understanding this Guide</li> <li>preparing worksheets</li> <li>facilitating IEMS sessions</li> <li>participating in IEMS development</li> </ul> </li> <li>&lt; Possible consulting assistance</li> <li>&lt; Training of personnel in new procedures</li> <li>&lt; Technical resources to analyze environmental impacts and improvement options</li> <li>&lt; Resources required to make changes</li> </ul> | <ul style="list-style-type: none"> <li>&lt; Improved environmental performance</li> <li>&lt; Expected increased efficiency/reduced cost of materials</li> <li>&lt; New customers/markets</li> <li>&lt; Enhanced employee morale</li> <li>&lt; Expected savings in compliance and overall compliance monitoring and assessment, and record-keeping requirements due to changes in materials used</li> <li>&lt; Reduced <b>waste</b> disposal/treatment costs</li> <li>&lt; Fewer regulatory requirements</li> </ul> |
| Contact Person:   | Date completed:  |

## Worksheet 1-2: IEMS Responsibilities

| IEMS Function             | Person          | Regular Position |
|---------------------------|-----------------|------------------|
| Management Representative |                 |                  |
| IEMS Coordinator          |                 |                  |
| IEMS Committee            |                 |                  |
|                           |                 |                  |
|                           |                 |                  |
| Contact Person:           | Date Completed: |                  |

Corresponds to RESP-01 in the *Company Manual Template*.

<sup>2</sup>Ibid, p. 5.

In addition, Figure 1-b shows the job functions and skills that would make a strong contribution to your IEMS team. Small companies might not have a person for each function identified on the table. The list is provided to identify skills that would be useful, not to suggest that a company would need all of these on a team.

*Figure 1-b. Functions to Include in Your IEMS Team*

| <i>Company Function</i>                               | <i>Expertise Brought to Project Team</i>  |
|---|---|
| <i>Production</i>                                     | <i>Management of environmental aspects of production</i>  |
| <i>Maintenance</i>                                    | <i>Management of environmental aspects of equipment maintenance</i>   |
| <i>Facilities Engineering</i>                         | <i>Management of environmental aspects of new construction and installation/ modification of equipment</i>          |
| <i>Storage/Inventory</i>                              | <i>Management of environmental aspects of raw material and product storage and in-facility transportation</i>       |
| <i>Shipping, Receiving, Transportation, Logistics</i> | <i>Management of environmental aspects of shipping, receiving, and transportation</i>                               |
| <i>Product Design</i>                                 | <i>System for examining environmental aspects of new designs</i>  |
| <i>Quality</i>  | <i>Quality management system, including document control procedures</i>   |
| <i>Human Resources</i>                                | <i>Training on environmental issues<br/>Inclusion of environmental incentives in performance measurement system</i> |
| <i>EH&amp;S</i>                                       | <i>System for complying with environmental regulations<br/>Management of environmental records</i>                  |
| <i>Purchasing</i>                                     | <i>System for procurement (including screening of suppliers, material composition of components)</i>                |
| <i>Sales/Marketing</i>                                | <i>Environment-related commitments to customers</i>   |
| <i>Public Relations</i>                               | <i>System for communicating with public on environmental issues</i>   |
| <i>Accounting/ Finance</i>                            | <i>System for tracking environmental costs of operations</i>  |

## Planning the Process

To effectively implement your IEMS, you will need to set up a plan for getting the work done. This plan will be unique to your company. You will identify the steps to take, in the appropriate order; the decisions that will need to be made; and the resources and schedules for accomplishing the tasks. Start out by considering the following points as you plan for your IEMS development:

- < Determine what level of management involvement is required and what decisions will be needed from both middle and senior management.
- < Set a deadline for developing your IEMS and establish a schedule. (See worksheet at the end of this module.)
- < Estimate a budget.
- < Determine how you will document your IEMS.

If you have never developed an IEMS before, estimating resources and time can be difficult. You will need to create a schedule and estimate resources for completing your IEMS. As you begin to work on each module, you may want to identify intermediate steps for which you will set target completion dates. At some points, you may need to alter the overall schedule. Worksheet 1-3 will assist you in developing and tracking this plan. As you go through each module, revisit this worksheet and list who is participating in each task and your estimated budget and schedule. Also, Worksheet 1-4 will help you identify and document the persons responsible for different parts of the IEMS and the resources needed to support their effort. You may not be able to completely fill out these budget and resource worksheets at the beginning of this process. In addition, the items in the worksheet blocks may change as you work your way through the IEMS process. These worksheets only present ideas to get you started.

## Worksheet 1-3: IEMS Development Schedule and Resources Worksheet

| Module   | Participants    | Budget | Target Completion |
|--|-----------------|--------|-------------------|
| Laying the Groundwork: Identifying Environmental Aspects                     |                 |        |                   |
| Intermediate steps: (As appropriate)   |                 |        |                   |
| Making the Commitment: Creating a Policy Statement and Determining the Scope |                 |        |                   |
| Intermediate steps: (As appropriate)   |                 |        |                   |
| Determining Significant Environmental Aspects and Setting Objectives         |                 |        |                   |
| Intermediate steps: (As appropriate)   |                 |        |                   |
| Setting Targets and Measuring Success  |                 |        |                   |
| Intermediate steps: (As appropriate)   |                 |        |                   |
| Developing Operational Controls  |                 |        |                   |
| Intermediate steps: (As appropriate)   |                 |        |                   |
| Evaluating Alternatives  |                 |        |                   |
| Intermediate steps: (As appropriate)   |                 |        |                   |
| Implementing Your IEMS   |                 |        |                   |
| Intermediate steps: (As appropriate)   |                 |        |                   |
| Setting Up Environmental Management Projects                                 |                 |        |                   |
| Intermediate steps: (As appropriate)   |                 |        |                   |
| Establishing Continuing Improvement  |                 |        |                   |
| Intermediate steps: (As appropriate)   |                 |        |                   |
| Contact Person:  | Date Completed: |        |                   |

### Worksheet 1-4: Persons Responsible for IEMS Development

| Roles  | Individual(s)<br>Responsible | % of Time<br>Designated | Budget |
|--|------------------------------|-------------------------|--------|
| "Management representative" having responsibility for implementing the IEMS (in small businesses, this could be the owner).  |                              |                         |        |
| IEMS Coordinator   |                              |                         |        |
| IEMS Team Participants   |                              |                         |        |
| Identifying and determining significance of environmental aspects.   |                              |                         |        |
| Identifying and determining applicability of legal and other requirements.   |                              |                         |        |
| Competency-based training.   |                              |                         |        |
| Operational controls.  |                              |                         |        |
| Emergency preparedness and response.   |                              |                         |        |
| Monitoring and measurement of "key characteristics" of operations and activities that can have significant environmental impacts (i.e., the "significant environmental aspects."). |                              |                         |        |
| Periodic evaluations of environmental compliance.  |                              |                         |        |
| Handling and investigating non-conformance with the EMS.   |                              |                         |        |
| Records management.  |                              |                         |        |
| Internal EMS audits.   |                              |                         |        |
| Contact Person:  | Date Completed:              |                         |        |

Note: Most of these blocks will be filled in as development of the IEMS progresses. This worksheet will help track progress and serve to remind the team and management of necessary assignments.

## Gathering Information and Identifying Environmental Aspects: Understanding Your Company's Possible Impacts

The work in this step mostly involves gathering and organizing information about your company's activities. Information gathering involves four activities:

- < map your company's activities and processes,
- < identify inputs and outputs for each activity and process step,
- < identify the environmental aspects associated with each input and output, and
- < identify regulatory and other requirements.

The process of identifying environmental aspects is best undertaken through group discussion with all levels of production employees, office staff, and managers. This helps to gain insight through different perspectives, and it engages everyone in the process of understanding the environmental component of your daily activities.

An **environmental aspect** is an element of your company's activities, products, or services that can affect the environment. Environmental **impacts** are the changes to the environment whether adverse or beneficial that result from your company's activities, products or services. Most elements of your business operations will have environmental aspects, intended or unintended.

For example, an unintended aspect of using a cleaning solvent may be that there are **volatile** (airborne) emissions produced during use. The "impact" of these emissions may be hazardous exposure to workers or the community or a contribution to smog formation. Another example is the business activity of making paper copies. The toner cartridges contain chemicals that could interact with the



Each DfE project begins with a simple mapping exercise to identify possible environmental concerns. Informed participants then select a priority concern that becomes the focus of the DfE project.

### **L** Tip

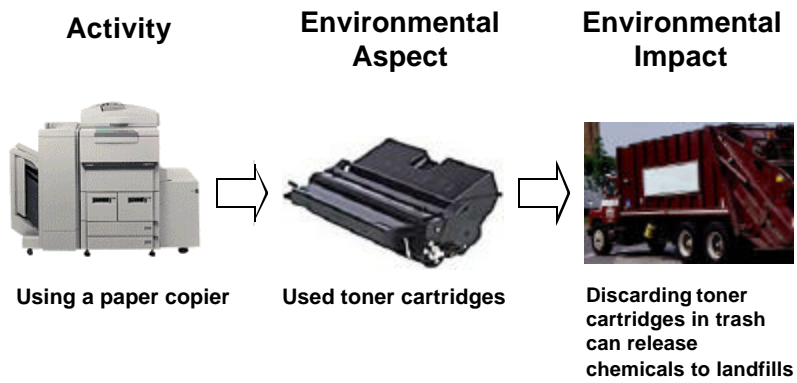
An environmental **aspect** is any element of your company's activities, products, and services that has the potential to affect the environment.

environment if they are not disposed of properly. The used toner cartridges with chemical waste would be an environmental aspect. The release of these chemicals into a land fill would be an environmental impact. Figure 1-c lists examples of environmental aspects and their potential impacts, and Figure 1-d graphically shows the relationship between activities, aspects, and impacts.

*Figure 1-c. Examples of Environmental Aspects and Associated Impacts*

| <i>Environmental Aspects</i>                            | <i>Potential IMPACTS of Each Aspect</i>   |
|---|---|
| <i>Metals discharged to POTW</i>                        | <i>Contamination of aquatic habitat and drinking water supply</i>                               |
| <i>VOC emissions</i>                                    | <i>Contribution to smog; worker or community exposure to volatile organic compounds (VOCs)</i>  |
| <i>Scrap generation</i>                                 | <i>Degradation of land, habitat, water supply</i>   |
| <i>Solid waste generation</i>                           | <i>Habitat destruction, drinking water contamination from landfills, wasted land resources</i>  |
| <i>Fresh water use</i>                                  | <i>Depletion of natural resources</i>   |
| <i>Electricity use</i>                                  | <i>Contribution to global warming; degradation of air quality by electric generating plants</i> |
| <i>Exposure to chemicals during business activities</i> | <i>Harm to health of workers, neighbors, wildlife or plant life</i>                             |

Figure 1-d. How an Activity Becomes an Impact



### Step 1: Develop a Process Map of Your Company's Activities and Processes

The first step in identifying environmental aspects of your business is to develop a map of your company's processes, products and services. First, categorize your business activities into areas or steps in the process, so that you can review them one by one. Some typical areas to consider might include:

- < Receiving Raw Materials
- < Storing Raw Materials
- < Manufacturing Process, Step 1
- < Manufacturing Process, Step 2
- < Manufacturing Process, Step 3
- < Packaging
- < Process Clean-up
- < Waste Disposal
- < Office
- < Building Maintenance
- < Shipping Product
- < Transportation (including employee, sales, and management staff, parking)
- < Optional: map customer and supplier activities and processes that directly relate to your company's activities, products and processes

Use this list of areas to develop a process map describing the order in which activities take place in your company. Some areas may need their own map; others could be parts of a larger map.

Figure 1-e shows a generic process map of a manufacturing company that might help you to set up your own map. Worksheets EA-01a and EA-01b in the *Company Manual Template* also provide a way to document your company's operations.

### Internet Help

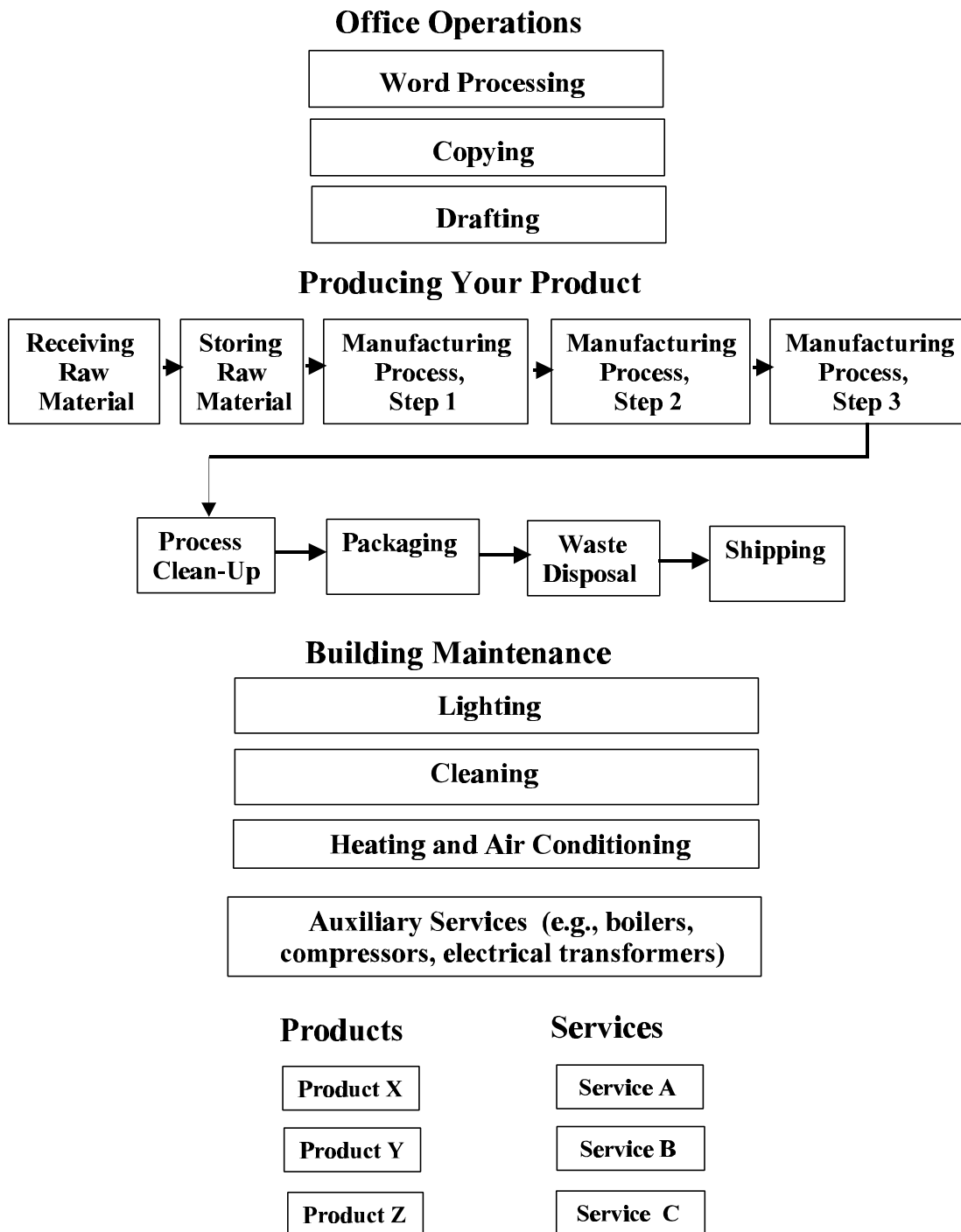
Visit the DfE website for more tools related to process mapping.

[www.epa.gov/dfe](http://www.epa.gov/dfe)

### **L** Tip

These technical sections are best developed through group discussions. There is no "right" way to build these lists. The process, however, must make sense to you and be documented so that you can review it or change it later.

Figure 1-e. Generic Process Map for Business Activities



You will notice that two areas of activities, office operations and building maintenance, have boxes that are separate rather than being part of a sequence. This is because the activities identified under these areas are not related sequentially. Under the area “Producing Your Product,” the activities are connected in steps required to produce a product or service. This order will be important to understand later if you decide to work on an aspect that is part of a sequence of steps.

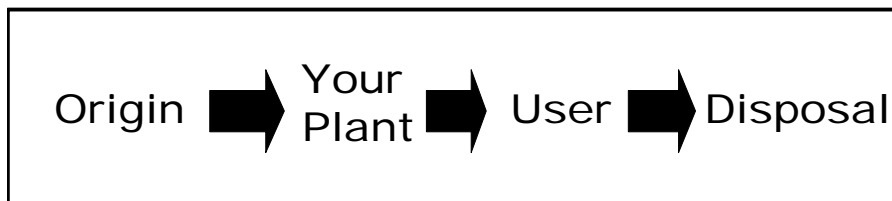
### **L Tip**

Appendix H contains full-page versions of the blank worksheets.

In addition to the process steps laid out in your map, you should consider the environmental aspects of your products and services. For example, does your product or its packaging have potential impacts on the environment? If so, there may be opportunities to form partnerships with customers to work on making changes that reduce the impact. As shown in Figure 1-f, many companies are extending their responsibility to consider the upstream impacts of their materials choices and the downstream impacts of consumer use and disposal of products.

*Figure 1-f. Product X — Extended Responsibility*

#### *Step 2: Identify the Inputs and Outputs of Each Activity*



The next step in identifying environmental aspects is to identify the inputs and outputs of each box in the process map you developed in Step 1. Among those inputs and outputs will be some that have environmental effects. Figure 1-g shows a generic step in a manufacturing process. Figure 1-h illustrates this concept with an example of a business activity (paper

copying) that is an office activity rather than part of an operational sequence. The second example, shown in Figure 1-i, shows the process step of press cleaning in printing operations at ABC company. Figure 1-j shows graphically the general inputs and outputs of a company's products and services.

Figure 1-g. Input-Output Diagram for a Step in a Manufacturing Operation

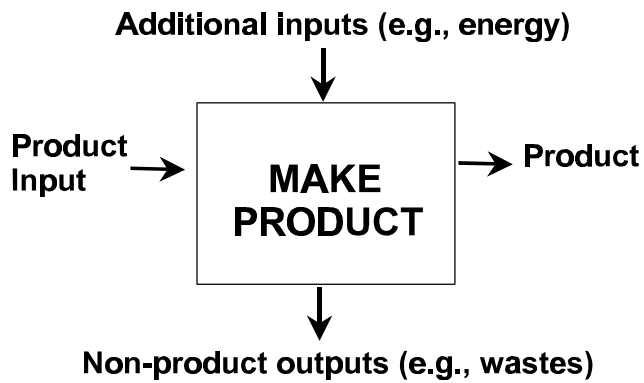


Figure 1-h. Input-Output Diagram for a Copier

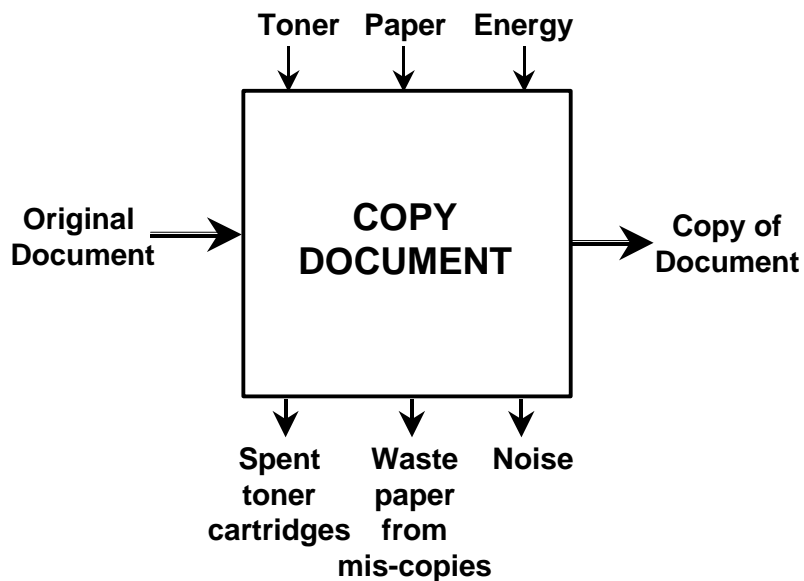


Figure 1-i. Input-Output Diagram for Cleaning a Printing Press

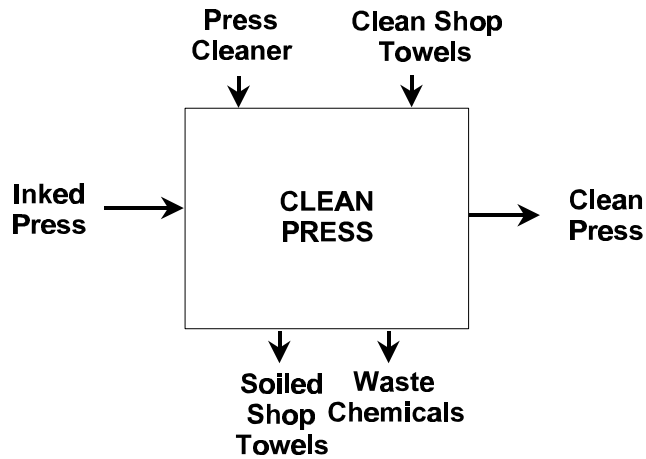
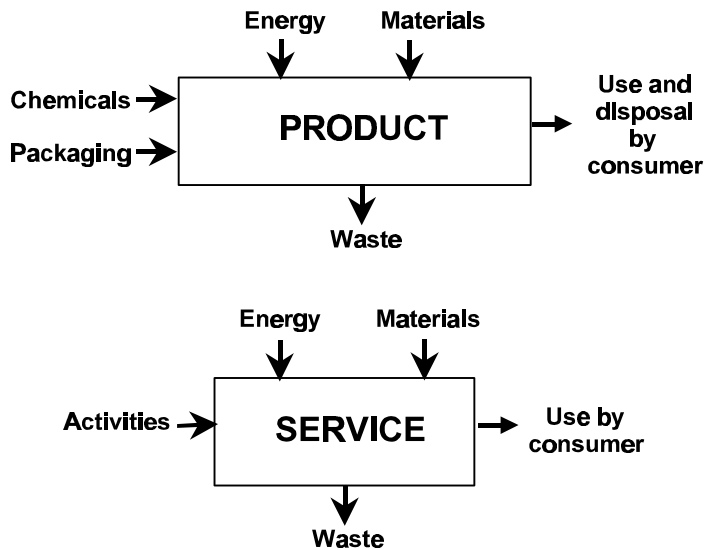


Figure 1-j. Inputs and Outputs of a Company's Products



and Services

Step 3: Identify environmental aspects of each activity

Next you will identify environmental aspects associated with each input and output. Using your process map developed in Step 2, identify the environmental aspect of each input and output. Keep the following key points in mind when identifying the environmental aspect of a particular activity.

- < Can it interact (beneficially or harmfully) with anything in the environment?
- < Can it be toxic or hazardous to humans or anything in the environment?
- < Does it use natural resources?
- < How is it disposed of?
- < If a product, how will it be used and disposed of by the consumer?

Use Worksheet 1-5 to help you list each process step and its associated environmental aspect. Appendix H contains a blank copy for your use.

| Worksheet 1-5:* Identifying Environmental Aspects                   |   |   |
|---|---|---|
| Input/Output  | Environmental Aspect<br>(Quantify if available)       | Environmental Impact                              |
| <b>Office Activities</b>  |   |   |
| Paper (In)  | Use of paper  | Use of natural resources                          |
| Energy & fuel (In)  | Use of energy   | Use of natural resources; air quality degradation |
| Toner (In)  | Harmful chemicals                                     | Health and environmental effects**                |
| Documents (In)  | Solid waste   | Degradation of land, habitat, drinking water      |
| Waste paper (Out)   | Solid waste   | Degradation of land, habitat, drinking water      |
| Used Toner (Out)  | Solid and chemical waste                              | Degradation of land, habitat, drinking water      |
| Odors (Out)   | Production of odors                                   | Indoor air quality                                |
| <b>Manufacturing Process</b>  |   |   |
| Press cleaner (acetone, toluene, MEK, isopropyl alcohol blend) (In) | Chemicals that are toxic to humans or the environment | Health and environmental effects*                 |
| Wipers (In)   | Materials that are toxic to humans or the environment | Health and environmental effects*                 |
| Energy & fuel (In)  | Use of energy   | Use of natural resources; air quality degradation |
| Soiled wipers (Out)   | Production of hazardous waste, solid waste            | Degradation of land, habitat, drinking water*     |
| Waste chemicals (Out)   | Production of hazardous waste, solid waste            | Degradation of land, habitat, drinking water*     |
| Air releases of press cleaner (Out)                                 | Production of air pollutants                          | Degradation of air quality*                       |
| <b>Products and Services</b>  |   |   |
| Product X: Chemicals  | Chemicals that are toxic to humans or the environment | Health and environmental effects*                 |
| Materials   | Materials that are toxic to humans or the environment | Health and environmental effects*                 |
| Packaging   | Production of hazardous waste, solid waste            | Degradation of land, habitat, drinking water      |
| Waste   | Production of hazardous waste, solid waste            | Degradation of land, habitat, drinking water      |
| Energy use  | Use of energy   | Use of natural resources; air quality degradation |
| Service X: Chemicals used   | Chemicals that are toxic to humans or the environment | Health and environmental effects*                 |
| Waste products  | Production of hazardous waste, solid waste            | Degradation of land, habitat, drinking water      |
| Energy use  | Use of energy   | Use of natural resources; air quality degradation |
| Contact Person:   | Date Completed:                                       |   |

\*Use the blank form in Appendix H for your data, then use the information to fill in EA-02 in the *Company Manual Template*. \*\* See Module 3 for information on chemical effects.

**Step 4: Identify your legal and other requirements**

The last step in identifying environmental aspects is to identify environmental legislative and regulatory requirements that pertain to your business activities, products, and services. Regulated concerns that apply to your business should be included in your system of environmental programs because your IEMS will integrate all of your company's efforts to manage environmental concerns.

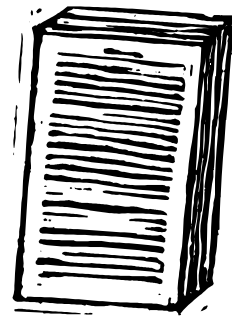
State and local legal requirements, in addition to federal, need to be considered. Often states administer federal environmental and occupational safety and health regulatory programs and may have stricter and/or different requirements than federal regulations.

You can obtain information on regulatory requirements from a variety of sources. State or city departments of environmental protection might be able to assist you in finding this kind of information. For example, state technical assistance programs are often excellent resources and often can provide one-on-one consultation. In addition, public information offices of both the Environmental Protection Agency (EPA) and the Occupational Health and Safety Administration (OSHA) of the Department of Labor (DOL) can help provide publications that explain regulations pertinent to your company's activities. Publications by the DfE Program at EPA and EPA's Office of Enforcement and Compliance Assurance (OECA) also identify federal regulations affecting certain industries. Appendix G gives full citations of the DfE publications, addresses for some resources, and describes how to obtain them. You can also visit the DfE Web site at [www.epa.gov/dfe](http://www.epa.gov/dfe). Regulatory information is also available at the websites of many agencies.

Worksheet 1-6 will help you organize your search of regulations that affect your business. In many cases, very small businesses

**L Tip**

It is helpful to begin identifying regulatory requirements by making a list of those regulations that you know affect your company. Searching for additional information can take time. Any newfound regulatory requirements can be added into your IEMS at a later date.

**L Tip**

Even regulations that may not directly apply to your business may contain important information about the environmental impacts associated with your type of business.

are exempt from some regulations. Still, the problems addressed by the regulations may affect your business and may be concerns you would want to address in your IEMS. Thus, it is worthwhile to familiarize yourself with regulations, just to identify concerns and determine whether any of them apply to your operations. Use Worksheet 1-6 to keep track of regulations that apply to your business.

| Worksheet 1-6*: Regulations |  |  |                               |
|-----------------------------|--|--|-------------------------------|
| Regulatory Agencies         | Regulations That Apply to My Business Sector | Business Operations Potentially Affected | Does it Apply to My Business? |
|                             |  |  |                               |
|                             |  |  |                               |
|                             |  |  |                               |
|                             |  |  |                               |
|                             |  |  |                               |
| Contact Person:             |  | Date Completed:                          |                               |

\*Corresponds to Table LR-01 in *Company Manual Template*.

In addition to regulations, industry codes of practice and other non regulatory guidelines can help point to environmental aspects of your business activities. Your trade association also may be able to help identify useful publications.

The following case study shows how “Company A” set up a process for creating an environmental management system and some of the benefits of doing so.

#### Case Study: Company A

##### EMS Development

Company A is a 20-person manufacturer of large custom metal machine parts for industrial customers. To initiate its EMS, the company formed a small EMS implementation team that includes the managers of quality, purchasing, and human resources and is led by the owner's son. This team developed the environmental policy for review and approval by the owner, and, equally important, set up a structure for involving all employees in the EMS process. Employees receive general environmental awareness training during some of the company-wide Friday meetings, and have been involved in identifying environmental problems and solutions in their areas of responsibility.

Company A's comprehensive approach to environmental management yielded immediate results. After identifying oil usage as a significant environmental aspect, a team of workers and managers identified faulty gaskets as the primary cause of oil leaking from the machines. By replacing these gaskets, the company cut its oil use by 50%. This change, as well as more general improvements in work environment and worker safety, caused the local environmental enforcement agency to reclassify Company A as a non-hazardous waste generator (it had been

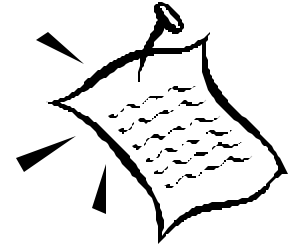
classified as a hazardous waste generator). The company also reports significant improvements in the environmental awareness of management and workers; though less tangible, this change in attitude may prove equally significant over the long run.

## MODULE 2: CREATING AN ENVIRONMENTAL POLICY

This module will help you review your company's current methods for managing environmental concerns, develop an environmental policy for your company, and determine the scope of your IEMS. Sample environmental policy statements are presented at the end of the module.

### Understand How Your Company Currently Manages Environmental Concerns

This step is designed to help you review how your company currently handles environmental and human health concerns and compares current practice with where you would like to be. In some references, this is called a “gaps analysis” because it is designed to uncover ways to improve your management of these concerns. This step is best developed through discussions with groups of employees representing different functions in your company, *especially line managers and line workers*. You'll need to involve people that have the day-to-day working knowledge of your company's operations. It is important for everyone to understand what the IEMS involves and why it is being implemented. In this way, they can then explore alternatives to your current practices, so as to improve both environmental management and cost savings for your company. It will be helpful to keep a list of answers for future reference.



#### Tip

Your discussion should be comprehensive and detailed enough to give you some idea of what will need to be done to develop an IEMS for your company.



Principles that can be a part of your environmental policy include a commitment to risk reduction, pollution prevention, and wise resource management.

#### Tip

The **environmental policy** is the foundation of the company's IEMS. Through it, top management should communicate goals such as preventing pollution and minimizing risk to workers and the environment.

Discussion Questions

1. Does your company have an Environmental, Health & Safety Policy?
  - < Is this policy written down?
  - < Where is it located?
  - < How many employees know about this policy?
  - < How did they learn of it? Is it included in a training or orientation program?
  - < Do employees have the opportunity to make suggestions regarding environmental concerns?
  - < What points are included in this policy?
  
2. Does your company have specific environmental or health & safety goals?
  - < Are these documented?
  - < How are these communicated to employees?
  - < Is there a way of tracking whether goals are met?
  - < Are there penalties within the company for not achieving the objectives?
  - < Is there a way to change these goals when changes in processes, production, or activities occur? How are these changes communicated?
  
3. Does your company have a process to identify all environmental, health & safety regulatory requirements?
  - < Has your company conducted compliance audits?
  - < Has your company received any fines or penalties requiring corrective action?

**L Tip**

Remember to consider worker health and safety, as well as people outside your plant, when evaluating known health concerns.

**L Tip**

The EPA National Enforcement Investigations Center (NEIC) has recognized the way in which an EMS improves a company's compliance record by providing a guidance document for developing a "compliance-focused" EMS. (See Appendix G for more information.)

- < Has your company experienced difficulties in complying with regulations?
  - < Are some regulations difficult/costly to meet?
  - < Does your company know whom to contact at local, state, and federal regulatory agencies in the event of environmental accidents or compliance concerns?
  - < Does your company have a mechanism for staying up to date on changing regulations?
4. How does your company evaluate risk to human health & safety and the environment caused by your business operations? How is this information incorporated into planning for business activities/production?
5. Is there a process within the company to review any changes in products or processes with an eye toward environmental concerns?
6. Are there policies and procedures regarding procurement and contracting that consider environmental concerns?
7. What training is offered at your company that would support environmental objectives?
- < Do employees receive environmental, health & safety training? What percent of employees? Which ones?
  - < How is that training documented? Where are the records kept?
  - < Is there provision for regular training on environmental, health & safety requirements?
8. Does your company have a procedure for responding to suggestions regarding environmental concerns that it may receive from customers, neighbors, or employees?

### **L Tip**

Reviewing these questions in six months and, again, in one year provides a good way to track progress in developing your IEMS.

- < Is there a process for soliciting and recording any “suggestions”? Where are these records kept?
- < Is there a process for following up on any of these suggestions to be sure that appropriate action was taken?

9. How does your company keep track of its documents?

- < Is there a filing system?
- < How many people are familiar with the system?
- < How many people have access to it?
- < How could someone find information relating to environmental, health & safety concerns? Are there Material Safety Data Sheets (MSDS) available? Does your company have documented standard operating procedures for plant operations, emergencies, or document control?
- < How are decisions made about when to dispose of documents?

10. How does your company identify potential accidents or emergency situations?

- < Are emergency procedures documented?
- < How do employees find out about them? Is there regular training?
- < Are these procedures periodically tested, evaluated, and revised as needed?
- < Have there been failures in response to accidents or emergency situations?
- < Is there a communications plan in place in the event of emergencies?

11. Does your company have a way of measuring the environmental effects of any of its operations?

- < Are there records kept?

### **L Tip**

As you discuss these questions, it will be beneficial to write down the answers for reference as you proceed with the following modules.

### **L Tip**

You should review this policy statement as you complete the modules following this one to determine whether changes need to be made.

- < How long?
- < Are these records reviewed regularly with an eye to whether performance has improved or worsened?

12. How does your company track its environmental costs?

- < Does your company track environmental costs such as on- and off-site waste handling and treatment?
- < Does your company track regulatory compliance costs such as labor costs for labeling, manifesting waste and/or permitting, and record keeping?
- < When purchasing materials and supplies, does your company consider things like handling costs, OSHA training, and shelf life?
- < Are the above costs allocated to overhead accounts or traced to products or activities?

## Internet Help



Visit the DfE website for more tools related to gaps analysis:  
[www.epa.gov/dfe](http://www.epa.gov/dfe)

## Environmental Policy Statements

An environmental policy is your declaration of commitment to the environment and worker health and safety. This policy serves as the foundation for your IEMS, and provides a unifying vision of environmental principles that will guide the actions of employees and management. This policy statement serves as the framework for setting environmental objectives and targets, and will be brought to life in your plans and business activities. Consider the scope of your environmental policy statement for that will also determine the scope of your IEMS.

### Refine Your List of Issues

Review the environmental aspects identified in Module 1. Make a list of general environmental concerns that could be addressed in your company's environmental policy statement.

### Set Your Boundaries

Think also about the scope of your policy. Decide whether it will include activities beyond internal operations, such as supplier environmental performance or customer product use. Remember to consider the company's property beyond plant walls up to the "fenceline." Consider how to include contractors working at your site, and consider companies you use for outsourcing. You will want to drop issues from your list that do not fall within the boundaries set for your policy statement. As you begin your IEMS, you may want to define your boundaries within the company. As you gain experience, you may choose to expand the scope of your IEMS to include environmental issues important to your customers and suppliers.

### Draft Your Environmental Policy Statement In General Terms

Address your list of specific issues in general terms in your policy statement. For example, if chemicals in your water or air are a concern because they potentially impact the community, you could express a commitment to review and, where feasible, make changes in the chemicals used by your company, or make sure you are managing them appropriately. Or, if solid waste in landfills is a concern in your area or to your company, you could express a commitment to reduce the solid waste your company produces.

Next, think about *how* to put commitments into action. For example, your commitment to reduce solid waste may be achieved through a pollution prevention program and/or a program to design products or services that result in minimal waste generated by the consumer. Also, these programs may be implemented one at a time over a several-year period, as part of your commitment to continuing improvement.

### Sample Policy Commitments

It is important to think through which commitments your company will be capable of addressing. Do not include commitments in your policy that the company will not be able to carry out. The following is a checklist of commitments or principles that you may wish to consider including in your policy statement:

- < Comply with applicable environmental or worker safety laws/regulations.
- < Work to achieve pollution prevention.
- < Prevent accidents.
- < Identify opportunities for risk reduction associated with the processes and chemicals used in your plant, the supplies procured, the products produced, and the disposal of waste products.
- < Consider the life cycle (from raw materials extraction and processing to use and eventual disposal) of products produced, including packaging, so as to affect how suppliers and end users impact the environment through your products.
- < Continue improvement in your use of cleaner technologies and processes, and in the safer use of chemicals.
- < Practice wise resource management, including conservation of limited resources and reuse and recycling of materials.
- < Consider which goals of industry or your trade association could be adopted for your environmental policy statement.

Make sure top management commits to the environmental policy statement. If possible, the company president should sign and date it. The final environmental policy statement should be posted or distributed to employees and other interested parties.

### Examples

The following are sample environmental policy statements that in some way incorporate most of the principles listed above.

### Resource



Review the *Company Manual Template* for examples of how to document your policy.

# YOUR COMPANY (ABC)

## HEALTH, SAFETY AND ENVIRONMENTAL POLICY

This is a sample policy. Adapt for your company.

ABC Company is committed to managing health, safety and environmental (HS&E) matters as an integral part of our business. In particular, it is our policy to assure the HS&E integrity of our processes and facilities at all times and at all places. We will do so by adhering to the following principles:

### COMPLIANCE

We will comply with applicable laws and regulations and will implement programs and procedures to assure compliance. Compliance with HS&E standards will be a key ingredient in the training, performance reviews, and incentives of all employees.

### RISK REDUCTION, PREVENTION, RESOURCE MANAGEMENT

We will seek opportunities, beyond regulatory compliance requirements, for reducing risk to human health and the environment, and we will establish and meet our own HS&E quality standards where appropriate.

We will employ management systems and procedures specifically designed to prevent activities and / or conditions that pose a threat to human health, safety, or the environment. We will look for ways to minimize risk and protect our employees and the communities in which we operate by employing clean technology, including safe technologies and operating procedures, as well as being prepared for emergencies.

We will strive to minimize releases to the air, land, or water through use of cleaner technologies and the safer use of chemicals. We will minimize the amount and toxicity of waste generated and will ensure the safe treatment and disposal of waste.

We will manage scarce resources, such as water, energy, land, forests, in an environmentally sensitive manner.

### COMMUNICATION

We will communicate our commitment to HS&E quality and to our company's environmental performance to our employees, vendors, and customers. We will solicit their input in meeting our HS&E goals and in turn will offer assistance to meet their goals.

### CONTINUOUS IMPROVEMENT

We will measure our progress as best we can. We will review our progress at least on an annual basis. We will continuously seek opportunities to improve our adherence to these principles and to improving our environmental performance, and we will periodically report progress to our stakeholders.

{Signature} President

Date

Adapted from: *Environmental Management Systems: An Implementation Guide for Small and Medium-Sized Organizations*. Ann Arbor, MI: NSF International, November 1996, p.3.

## SAMPLE POLICY

This is the environmental policy of a small environmental services company specializing in wastewater treatment and laboratory analysis of effluent. The policy should be signed by the company's President.

We supply quality products and services. This requires the commitment of everyone working in this institution to pursue our activities safely, protecting our health and preserving the environment.

To realize this vision we will:

- Establish and review periodically our environmental goals within a program of continual improvement.
- Comply with legal requirements pertinent to our industry and with the requirements of other initiatives we enter into in accordance with our commitment to offer quality products and services.
- Conduct laboratory analyses and supply environmental services without risk to workers' health.
- Operate the laboratory with a minimum of waste, in current and future operations.
- Pursue our work with a minimum of disturbance to our neighbors and the community.
- Maintain our vehicles in optimal condition to minimize their consumption of fuel and their emissions to the atmosphere.
- Manage our chemical products safely, principally to prevent spills in their storage and transport.

This policy and any subsequent modifications should be familiar to all employees and available to the public. Implementation of this policy is a primary objective of the President and the responsibility of all employees.

{Signature}

President

Date

## CASE STUDY: COPY PLUS SERVICES

Sam Worth, owner of a copy center business, was attending a conference on issues affecting small businesses. The conference was the first of this type that Sam had attended. His business, Copy Plus Services, has five centers located in the western suburbs of Chicago. Each center provides a full range of copy services including fax, binding, computer usage, video conferencing, and blueprint service. The centers are run 24 hours a day and seven days a week. Sam grew the business from a simple copy center located in Elgin, Illinois, five years ago and is planning to go national with the business.

During one of the small group sessions, Sam and five other attendees were discussing how their businesses affected the environment. One of the presentations had mentioned a new standard — ISO14001 Environmental Management Systems — which applies to service businesses as well as manufacturers. None of the people in Sam's small group was familiar with the standard. They decided to share with one another what they'd been doing in their businesses to protect the environment and then review the ISO 14001 standard.

Naturally Sam's five copy centers recycled waste paper. However, beyond that Sam had never thought of other environmentally conscious programs that they could implement. He was a bit embarrassed that he had not really given it much thought. He has had complaints of odors bothering the people in stores adjacent to his centers. In an attempt to appear as if he had given it some thought, Sam told the group that he had a good quality program which he thought addressed environmental issues, and that one of his centers had received an ISO 9001 quality award for doing quality work.

For the most part, the other members of the group had also not given environmental programs much thought. They didn't have any specific issues confronting them and were somewhat concerned about embarking on a program for which they could not see any beneficial return and that might be a big cost to the business. Since they had never dealt with the EPA, they were leery of the possibility that EPA might come into their business if they participated in the ISO 14001 program.

One of the group members said that, from what she had read on environmental programs in Business Week, there were benefits to be derived by undertaking such a program. Since these programs had to be integrated into the overall business plan, it seemed important that top management provide the leadership in incorporating environmental stewardship. She cited some examples of this from case studies she had read, as well as from her personal experience. One of the examples was an ice cream business in Chicago, which increased its overall productivity by focusing on energy efficiency. In addition, an international clothing distributor used the environment as a major selling point for its product.

After Sam returned home from the conference, he sat down and thought about what had been discussed in the small group session. He wanted to start an environmental program in his business but was not quite sure how to proceed. He decided to draft an environmental policy for his Copy Plus Service before going to bed, and present it to his staff at their weekly meeting the following Tuesday.

At the meeting Tuesday, Sam presented his environmental policy to his staff. Sam's staff was composed of the managers of the five centers, a finance manager, and himself. The reaction from the group was split. Two of the managers felt that, other than recycling the paper, there wasn't anything of significance that they could do within their business. The other three seemed to think that this was something worth pursuing. The finance manager was on the fence. While she acknowledged that there might be some ideas for them to pursue, she was concerned that it would add cost to the business. The copy business was a low-margin business and competition was increasing.

### L Tip

Sam may have had a better response if the managers had all participated in developing the policy together.

Although Sam knew that everyone wasn't equally committed, they all agreed to pursue the idea further. The finance manager and the two managers who were enthusiastic would review Sam's environmental policy to determine whether it was appropriate for the business. If so, they would help figure out how it could be incorporated into the business. Sam suggested that they might want to talk with someone else in the copy business to see what they are doing about environmental programs. The finance manager said that she knew someone from The Body Shop, also in the mall, who had worked on a committee to develop their environmental program. They all agreed that the friend should be invited to join them for a meeting as an outside observer and advisor.

### L Tip

So far Sam has only involved managers. He should now include employees from all levels of the company.

When the three managers met, Laura Witherspoon from The Body Shop, a neighboring store in one of the malls, was able to attend. She agreed to provide her perspective and ideas in establishing an environmental management system. The first order of business was for them to explain their operation to her.

### Copy Center Operations

Each copy center produces a million copies per year using premium grade paper. Of that output, 70% is single-sided copies. Each copy center also does a significant amount of blueprint business. There are fifteen employees per center. Each center's energy bill is \$50,000 per month. The majority of the work is done during 9 AM to 6 PM business hours. They recycle approximately 100,000 pieces of paper per year in each center. Each center uses 400 toner cartridges and two gallons of ammonia per month. Supplies are stored on shelves in a back room and chemicals are stored either in metal cabinets or next to the machines (for easy access). Copy Plus Center customers come both through newspaper advertising and pamphlets, and through their Web site.

**Equipment:** The copy machines and computers are three to five years old. They are typically left on 24 hours a day. The managers are not sure if any of the chemical products used in the copy and blueprint equipment have an impact on the environment.

**Location:** The Copy Plus centers are in shopping malls and residential areas. Businesses in the area such as restaurants have expressed concern over the odors coming from the centers.

**Delivery Service:** Each center has vans providing customer pickup and delivery. In addition, the vehicles are used to pick up supplies for the centers.

**Cleaning Service:** Each center contracts with a cleaning service that cleans the facilities. A waste disposal company handles the waste, and recycling is subcontracted.

**Training:** Employee training focuses on running the equipment and administrative procedures, including paper recycling.

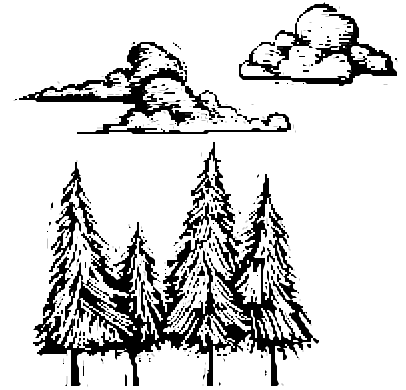
Considering this information, Laura suggested that they approach environmental management system implementation not just from the standpoint of the copy center operation but from a total systems approach. Laura presented a simple input/output model to begin the process of understanding the environmental aspects of the business. The three managers immediately recognized the possibility and benefits of this approach. They asked Laura if she would be willing to prepare a rough plan that described this approach in more detail, and outlined a typical copy center environmental management system. Laura agreed because she remembered how difficult it was to get the synergy in her own organization. She felt that she could assist them with this.

## MODULE 3: DETERMINING SIGNIFICANT ENVIRONMENTAL ASPECTS AND SETTING OBJECTIVES

From your work in Module 1, you have probably identified a number of “environmental aspects” associated with your company’s activities. This module will help you prioritize those aspects. It will also help you determine which one(s) you will want to work on first. Do not expect to work on all the environmental aspects identified. “Continuous improvement” implies that this is an on-going process where you address some concerns now and others in the future.

Your operations may have many environmental aspects, but they may not all be significant. First, by ranking each aspect against a set of environmental criteria (e.g., toxicity, wasted materials), you can determine which are most significant. Next, to select which significant environmental aspects (SEAs) you will work on, rank each aspect against practical criteria (e.g., technical and economic feasibility) and benefits criteria (e.g., improved health). For those aspects you select, you will set objectives in terms of the improvements you hope to make.

Determining which aspects are significant includes making subjective decisions. For this reason, you will improve results by having a team of people who represent different job categories. They can provide a cross-section of operational experience when you work on this module.



DfE projects emphasize integrating evaluation of both risk and resource conservation into performance and cost evaluations.

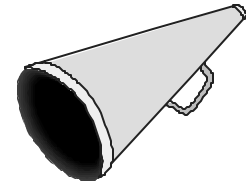
## Create a Working List of Environmental Aspects

When you developed a list of environmental aspects using the process map of your company's activities, you may have identified a large number of environmental aspects. This is not surprising, since virtually all of your business activities could interact with the environment in some way. In order to identify which environmental aspects are significant, we will review environmental risk information. However, ranking your environmental aspects using environmental risk information can be a labor-intensive process. Therefore, you may want to create a smaller list of environmental aspects to rank using risk information.

First, create a list of selection criteria that suit your company.

Below is a list of examples to help you get started:

- < Which aspects might affect your company's ability to comply with regulations and other requirements?
- < Are there pollution prevention opportunities?
- < Are there potential cost savings or business opportunities (e.g., potential customers who require their suppliers to have EMSs)?
- < Are there concerns that might be shared by customers or suppliers?
- < Is there "low-hanging fruit" that might provide early successes which can serve both to educate employees and to build confidence in the IEMS?
- < Are there opportunities to integrate environmental with worker health and safety requirements?
- < Are there community concerns regarding your company's activities?
- < Are there unregulated hazardous chemicals that could be managed better or substituted?



***In describing the approach used to identify and prioritize SEAs, one screenprinter stated that his company:***

"Brought in a cross-section of staff and conducted facilitated brainstorming. They then captured the information in a matrix to help prioritize aspects."

***Another said his company used "common sense." He said,***

"A quick walk around any print shop will produce at least enough SEAs to get an IEMS project under way."

- < Are some of your “solutions” to environmental concerns or regulations shifting waste from one media (air, water, land) to another?
- < Could resources be used more efficiently, e.g., energy, water, materials?

You may want to use all or some of these, and you may think of others specifically related to your company’s circumstances.

Create a list of criteria and use that to select a group of environmental aspects to rank.

There are several ways to make this selection. One way is for the IEMS team to review the list of environmental aspects and vote on their top concerns. Set a target number to rank, say ten, and let the top ten environmental aspects be your working list.

When you have a reduced list of environmental aspects (e.g., ten), you are ready to rank them using environmental risk information to determine which are significant environmental aspects.

## Using Environmental Risk Information to Rank Your Environmental Aspects

Although you will not attempt a formal risk assessment for your IEMS, this module will help you apply your working knowledge and judgment about the chemicals and materials your company uses, and the way in which they are used, to select environmental goals to help create healthier working conditions, communities, and environments. This section presents a brief introduction to the concept of risk and to ranking symbols. Then it presents methods to gather chemical and material **effects** information and rank aspects according to effects; a method for making judgments about **exposure** to chemicals and materials and rank aspects according to exposure; a method for laying out risk as well as other environmental concerns and ranking aspects considering

### **L** Tip

Remember: “aspect” refers to the potential for environmental impact. A significant aspect would have the potential for large impact, either because impact is likely to occur under current operating conditions, or because there is potential for serious impact. Even aspects that are well-controlled should be considered for their **potential** for impact should controls fail.

these factors. In addition, methods for ranking environmental aspects as projects in terms of cost and expected improvements are presented as a way to prioritize projects that your company will undertake to get started on your IEMS.

### Risk

Risk assessment, in brief, is a process that integrates the work of several sciences to determine the kind and degree of environmental and human health impacts *potentially* produced by *exposure* to a chemical or material.

Risk is composed of two parts: toxicity (hazard or “effects”) and exposure. *Toxicity* is the ability to cause harm to the health of humans, wildlife, or vegetation, as well as the type and seriousness of that effect. You will collect the information needed to form a judgment about effects in Worksheet 3-1. You will review the chemical effects information for each aspect and give a rank based on your judgment of the seriousness of the effects of this chemical or substance.

*Exposure* is the *amount* of material with which workers, the community, or the environment come into *contact*. The amount is determined by both *severity* and *time* of contact. Severity refers to the amount of material that one can come into contact with at any one time. The time of contact depends on the number of times that contact occurs in a given period (the *frequency* of contact) and the *duration* of the contact. You will collect the information needed to form a judgment about exposure in Worksheet 3-2.

Contact with humans and animal or plant life is characterized as occurring along pathways. These pathways describe the routes along which the substance must travel, before it enters an animal or plant, and how the substance is taken up by the living organism.

### Tip

Visit the DfE website for more tools related to risk.

[www.epa.gov/dfe](http://www.epa.gov/dfe)

Several pathways for human exposure include:

- < breathing the material (inhalation pathway),
- < touching the material (skin or dermal pathway), and
- < ingesting (eating or drinking) the material (oral pathway).

#### Using Ranking Symbols

One way to rank environmental aspects is to use symbols representing a range of high (H) to low (L). Whatever ranking you use (Figure 3-a shows an example), phrase the meaning consistently across all ranking categories; this is most straightforward if you think of “high” as meaning a project you would ultimately like to undertake and “low” as one having lesser priority. Thus, when considering environmental effects, a chemical receiving a “low” rank would be one with low impact or good environmental performance.

*Figure 3-a: Ranking Symbols*

| <i>Symbol</i> | <i>Meaning</i>         | <i>IEMS Meaning</i>                |
|---------------|------------------------|------------------------------------|
| <i>H</i>      | <i>High</i>            | <i>Most environmental impact</i>   |
| <i>M-H</i>    | <i>Moderately High</i> | <i>More environmental impact</i>   |
| <i>M</i>      | <i>Moderate</i>        | <i>Medium environmental impact</i> |
| <i>M-L</i>    | <i>Moderately Low</i>  | <i>Lower environmental impact</i>  |
| <i>L</i>      | <i>Low</i>             | <i>Lowest environmental impact</i> |

## Identify and Rank Potential Human Health and Environmental Effects of Chemicals and Materials

To rank the environmental aspects associated with chemicals and materials used in your business operations, you will need to find information on the human health and environmental effects associated with those chemicals. Without this information, you cannot identify the potential impact of each chemical on the environment. Unfortunately, there is no single and comprehensive source of information for most chemicals. Information that will help you understand the effects associated with the chemicals you use may be located in several different sources.

By taking the time and effort to find information about the chemicals you use, you will be able to understand the potential effects of the chemicals on humans and on the environment. You will also know how to use them in a way to minimize or avoid harmful effects. You can decide whether you want to continue using your current chemicals, or find alternatives that would mitigate any potential harmful impact.

Sources of information about chemicals include:

- < Manufacturer's Safety Data Sheets (MSDSs). These are supplied by the manufacturer according to OSHA regulation. You should receive a MSDS with any chemicals you purchase. They should be kept in a location that is available for review.
- < Your suppliers. Ask them for hazard and exposure information on any products you purchase. Ask them to supply the environmental information that is not on the MSDS.
- < Your trade association.
- < EPA or state environmental agency.
- < Online sources in various websites, e.g. various EPA programs. (EPA's DfE Program website contains a Risk

### **L** Tip

See Appendix B for a list of sample questions to ask your suppliers.

### **L** Tip

Remember, any chemical strong enough to take the place of human labor or to make human labor easier is strong enough to have some kind of environmental risk associated with it. The challenge is how to best manage that risk.

Guide with additional information.)

Organize the information you have into a format that will enable you to make comparisons between aspects. You may find that sometimes there exists very little information for a particular chemical. That discovery in itself is useful. By using this format and showing where information gaps occur, you will know that whatever decision you make now about using a specific chemical may change if information becomes available at a later date. Although you may want to use the chemical now, you may need to make adjustments later when more information becomes available. Worksheet 3-1 will help you organize your information on the chemicals you use in your business activities. The column headings list the categories and specific information needed. The final column asks for your judgment about the ranking of the environmental concerns associated with the chemical or material under consideration.

Figure 3-b lists the kinds of information OSHA requires on an MSDS. Most of the kinds of data listed below can be used to fill in the columns on Worksheet 3-1. Much of the environmental information will have to be found elsewhere.

In addition to carcinogenicity information and qualitative descriptors of health hazards (e.g., sensitizer, causes dizziness, etc.), MSDSs sometimes include *quantitative* toxicity values, which are important for assessing chemicals hazards. These include lethal dose (LD) and lethal concentration (LC) measures, which are typically from laboratory studies done on small mammals such as rats, mice, or rabbits. These measures are used to give guidance as to the dose required to kill a human. This is important information; however, interpreting its meaning is difficult. In general, if you are comparing several chemicals that have LD or LC measures, the lower measure is the most potent (it

means that it takes less to be lethal). Therefore, you would have to be more careful using the chemicals with the lower LD or LC measures, *as compared to* those having higher measures. Be sure to record any quantitative toxicity values found on an MSDS, as well as the more qualitative information.

### *Figure 3-b: Information on an MSDS*

As defined by the Occupational Safety & Health Administration (OSHA) (29 CFR 1910.1200), an MSDS is written or printed material concerning a hazardous material which contains the following:

- < The identity of the hazardous material (except as provided for materials that are trade secrets).
- < The physical and chemical characteristics of the hazardous chemical (such as vapor pressure, flash point).
- < The physical hazards of the hazardous chemical, including the potential for fire, explosion, and reactivity.
- < The health hazards of the hazardous chemical, including signs and symptoms of exposure, and any medical conditions which are generally recognized as being aggravated by exposure to the chemical.
- < The primary route(s) of entry.
- < The OSHA PEL (Permissible Exposure Level), the ACGIH (American Conference of Governmental Industrial Hygienists) Threshold Limit Value, and any other exposure limit used or recommended by the chemical manufacturer, importer, or employer preparing the MSDS, where available.
- < Whether the hazardous chemical is listed in the National Toxicology Program (NTP) Annual Report on Carcinogens (latest edition) or has been identified as a potential carcinogen in the International Agency for Research on Cancer (IARC) Monographs (latest editions) or by OSHA.
- < Any generally applicable precautions for safe handling and use which are known to the chemical manufacturer, importer, or employer preparing the MSDS, including appropriate hygienic practices, protective measures during repair and maintenance of contaminated equipment, and procedures for clean-up of spills and leaks.
- < Any generally applicable control measures which are known to the chemical manufacturer, importer or employer preparing the MSDS, such as appropriate engineering controls, work practices, or personal protective equipment.
- < Emergency and first aid procedures.
- < The date of preparation of the MSDS or the last change to it.
- < The name, address, and telephone number of the chemical manufacturer, importer, employer or other responsible party preparing or distributing the MSDS, who can provide additional information on the hazardous chemical and appropriate emergency procedures, if necessary.

# Worksheet 3-1:<sup>a</sup> Health, Safety and Environmental Potential Effects Information

| Operation          | Environmental Aspect | Information Sources     | Regulatory Data: <sup>b</sup><br>Carcinogen?<br>OSHA Permissible Exposure Limit (PEL)?<br>Volatile Organic Compound (VOC)?<br>Toxic Release Inventory (TRI)? | Human Health Effects by Pathways<br>Acute and Chronic <sup>c</sup> |                        |                           | Effects on Wildlife and Other<br>Environmental Effects <sup>d</sup> |                      |             | Worker Safety | Rank  |             |
|--------------------|----------------------|-------------------------|--|--|------------------------|---------------------------|---|----------------------|-------------|---------------|-------|-------------|
|                    |                      |                         |  | Inhalation   | Dermal                 | Oral                      | Air   | Water                | Land        |               | Human | Environment |
| Manufacture Step 1 | Chemical 1           | MSDS, trade association | yes<br>10 ppm<br>no<br>no  | Chronic:<br>cancer<br><br>Acute:<br>dizziness                      | Chronic:<br>sensitizer | acute:<br>LC50 of 100 ppm | ozone depletion   | Acute:<br>kills fish | kills worms | flammable     |       |             |
|                    |                      |                         |  |  |                        |                           |   |                      |             |               |       |             |
|                    |                      |                         |  |  |                        |                           |   |                      |             |               |       |             |
| Contact Person:    |                      |                         |  | Date Completed:  |                        |                           |   |                      |             |               |       |             |

<sup>a</sup> Corresponds to Table EA-03 in *Company Manual Template*.

<sup>b</sup> Most information for this column can be found on the MSDS.

<sup>c</sup> Partial information for these columns might come from the MSDS, but other resources may be needed. In particular, acute effects are usually reported on MSDS sheets. Chronic effects are sometimes on MSDS sheets, but often will have to be found elsewhere. LC refers to lethal concentration. Inhalation LC50 is the concentration of a chemical in air that causes death in 50 percent of the test organisms at the end of the specified exposure period. LD refers to lethal dose. LD50 is the dose of a chemical taken by mouth, absorbed by the skin, or injected that is estimated to cause death in 50 percent of the test animals. Lethal dose data are expressed in terms of amount of chemical divided by the body weight, e.g., mg/kg.

<sup>d</sup> MSDSs usually do not include environmental effects.

Note: This worksheet provides an example of the kinds of information found on an MSDS, but it is not a part of the press cleaning example. For more information on risk-related data, including methods for interpreting quantitative toxicity values, refer to the Risk Guide provided on the DfE Program website.

## Rank Exposure to Chemicals and Materials

In determining exposure, the amount of material as well as the frequency and duration of contact must be considered. An important element in exposure is contact. If there is no possibility of contact occurring, then there may be no exposure and therefore no risk. In some cases, as when a toxic substance such as lead is embedded in a product such that no contact occurs during use of that product, the toxic substance may still leach out of that product if it is disposed of in a landfill. The possibility of contact throughout the use and disposal of a product should therefore be considered. If, however, a toxic substance is contained such that neither humans nor the environment would come into contact with it, then exposure would be low. In ranking such a chemical use the rank given to the “Workers,” “Community,” and “Environment” would be “Low” (L). In ranking exposure, it is, therefore, necessary to consider how contact might occur and whether, in fact, it does.

### Severity (Quantity)

Determining the quantity of chemical or material that humans or the environment are exposed to can be difficult, especially if the substance becomes diluted in air as vapor or dust or in water. Potential exposure is affected by both the amount of a chemical product used and the concentration of the subject chemical in the product. First, determine the quantity used per time period (shift, week, month, year). If the chemical of interest is part of a product, then apply the percentage that the chemical constitutes in the product to the total usage of the product to determine the quantity used of that chemical. For example, a product may be a single, pure chemical (such as a solvent), or it may be a dilute water-based mixture, with the active ingredients being only a small percentage of the total amount. The higher the concentration, the higher the potential exposure to that ingredient. See the Exposure section of the Risk Guide on the DfE website for more

information on evaluating the exposure amount and ingredient concentrations.

#### Exposure Time

In addition to quantity, the duration of contact determines the exposure to a chemical or material. How often is the chemical or material used and for how long? The time period used should be related to that used for quantity. For example, if you measure quantity per month, then the time periods should show how many times (frequency) and for how long (duration) it is used per month. Use whatever time frame works with your business operation, but be consistent.

#### Personal Protective Equipment

The use of personal protective equipment (e.g., gloves, eye protectors, breathing masks) can greatly alter exposure to a chemical or substance, for the personal protective equipment provides a barrier that prevents or reduces contact. Even though personal protective equipment is used, some exposure may occur because people are not perfect in their adherence to instructions and because equipment fails. Consider the possibility of failure when making judgments about exposure to chemicals and materials.

#### Pathways

Substances can come into contact with living organisms through air, water, land, and other solids. For example, chemicals and substances can be inhaled from the air in the form of dust, vapors, and mists. Humans can ingest chemicals and substances in liquids or food. Substances can get into liquids or food by falling into them from the air, or by food coming into contact with chemicals on surfaces or hands. Finally, touching the chemical or substance can occur when dust, mists, or vapors contact bare skin or when unprotected hands touch contaminated surfaces. Animal and plant life can take up chemicals and substances from the environment in

#### **L** Tip

See the Exposure section of the Risk Guide on the DfE website for more information on evaluating the exposure amount and ingredient concentrations.

much the same way. Figures 3-c and 3-d show some typical exposure pathways for chemicals used in business operations. When ranking aspects, determine how contact might occur; then decide how severe that contact actually is and how much time is involved (the frequency and duration of contact). (For consistency in comparisons between criteria, apply the same time period to every aspect in your ranking exercise.)

Worksheet 3-2 will help you think about the exposure for each chemical you consider. This chart can be filled in for each chemical or material and represents your best judgment about exposure. The rank for each can then be placed in the last column. The rank represents your judgment.

## Worksheet 3-2: Exposure to Chemicals and Materials

| Operation         | Aspect   | Quantity*<br>Used per<br>time period | Exposure Time |                    | Personal<br>Protective<br>Equipment<br>(PPE) | Pathway                                  |                                     | Rank Exposed Groups |           |                  |
|-------------------|--|--------------------------------------|---------------|--------------------|--|--|-------------------------------------|---------------------|-----------|------------------|
|                   |  |                                      | Duration**    | Frequency          |  | Human:<br>Inhalation,<br>Dermal,<br>Oral | Environment:<br>air, water,<br>land | Workers             | Community | Environ-<br>ment |
| press<br>cleaning | acetone,<br>toluene,<br>MEK,<br>isopropyl<br>alcohol<br>blend<br>air<br>releases | 24 oz. per<br>day                    | 10 min.       | 5 times per<br>day | gloves                                       | inhalation                               | air,<br>water                       | H w/o PPE           | L         | M-L              |
|                   |  |                                      |               |                    |  |  |                                     |                     |           |                  |
|                   |  |                                      |               |                    |  |  |                                     |                     |           |                  |
| Contact Person:   |  |                                      |               | Date Completed:    |  |  |                                     |                     |           |                  |

\*If ingredient in chemical product, use quantity of chemical not product, i.e., apply the percentage that the ingredient makes up of the product.

\*\*How many minutes or hours per day is the chemical or material used?

Note: For more information about evaluating exposure, refer to the exposure section of the Risk Guide on the DfE Program website.

Figure 3-c: Screen Printing Exposure Pathways

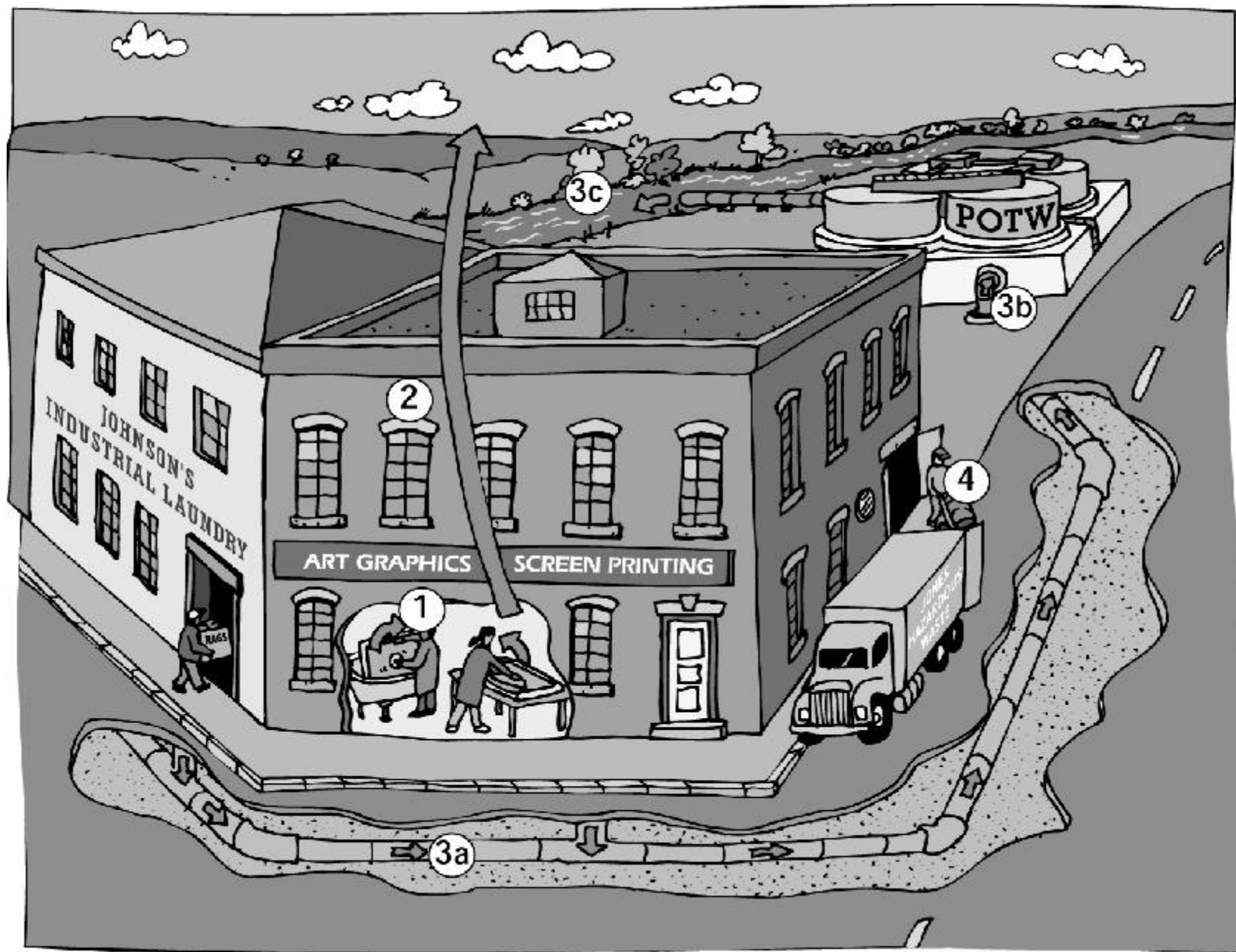
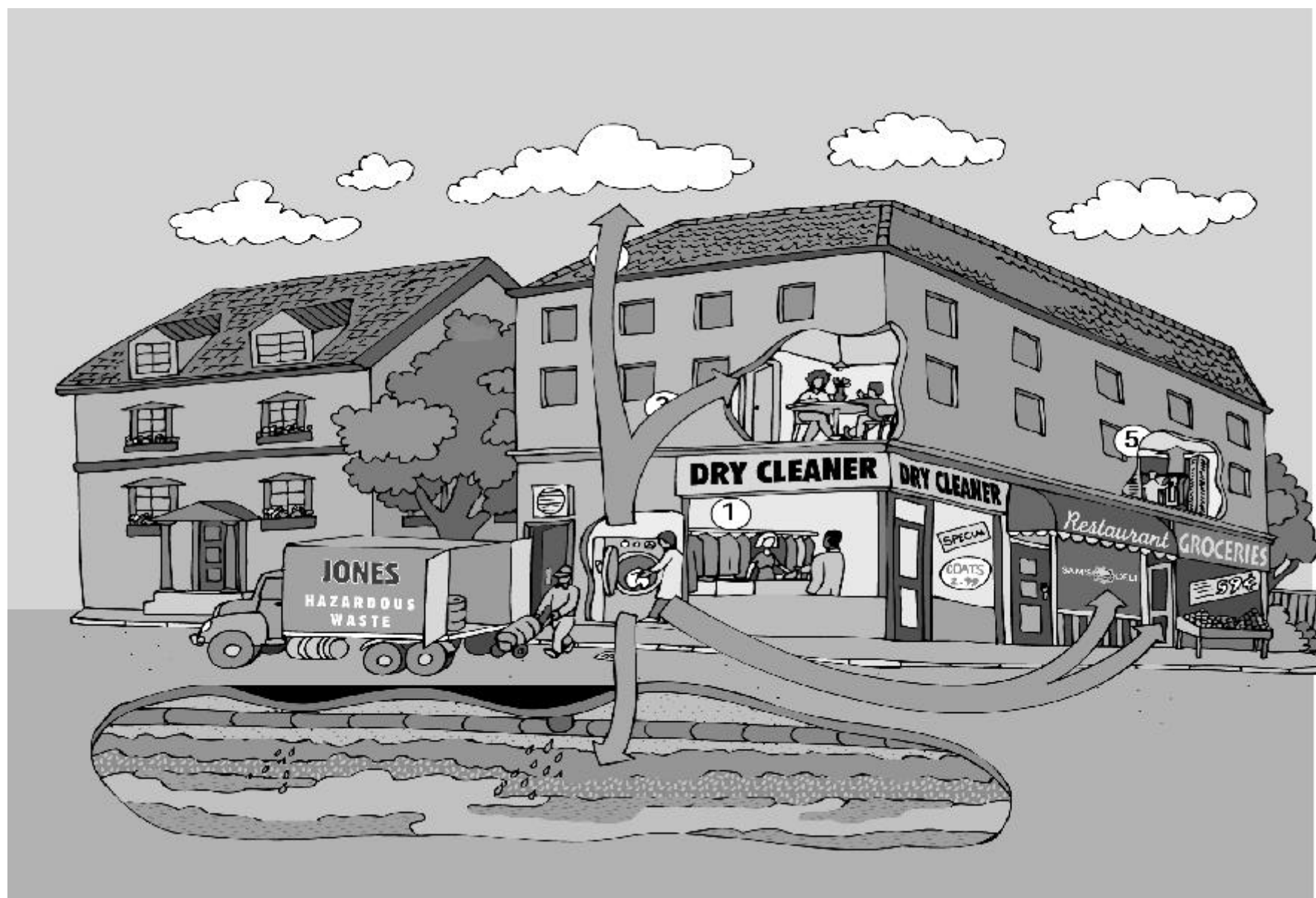


Figure 3-d: Dry Cleaning Exposure Pathways



## Ranking Your Significant Environmental Aspects

Now you will put the Effects information together with the Exposure information and consider some additional information. The following paragraphs explain how to use Worksheet 3-3 to rank significant environmental aspects.

### Regulatory Concerns

For each aspect, refer to the regulations associated with it that were identified in Module 1 and decide how important these are to your company. For example, an aspect might be regulated, but your company might be small enough that it was exempt from the regulation. The regulatory concern for your company might therefore be considered low (i.e., not important enough for a project). On the other hand, your company might have an environmental aspect to which a regulation applies. If you can stay in compliance easily, you might also rank the regulatory concern low. Or, if the cost of compliance is large or you have experienced difficulties in meeting compliance, you may rank this high (meaning that it may be a good candidate for a project). You do not need at this point to define your aspect in terms of an environmental concern. That will show up as you rank the remaining columns for this aspect.

### Chemical and Material Risk

Place both the ranking for effects and the ranking for exposure from Tables 3-1 and 3-2 in the columns. The effects rank for humans would be placed in both the worker and community columns.

### Worker Safety

Look at the information in Worksheet 3-1 under worker safety and apply a judgment of ranking. Enter this rank in the worker safety column.

### Other Community Issues

There are a variety of community concerns that might affect your designation of a particular activity as a significant aspect. These are issues other than pollution. Some examples are the noise level or odor produced by your plant; increased traffic caused by your business; and increased light needed for your operations. You may come up with others specific to your operation and your community. Worksheet 3-3 provides a place to document and rank these issues. Place the rank from this worksheet in Worksheet 3-5.

| Worksheet 3-3: Community Issues |        |                         |      |
|---------------------------------|--------|-------------------------|------|
| Operation                       | Aspect | Community Issues (List) | Rank |
|                                 |        |                         |      |
|                                 |        |                         |      |
|                                 |        |                         |      |
|                                 |        |                         |      |
|                                 |        |                         |      |
| Contact Person:                 |        | Date:                   |      |

## Natural Resources

This criterion should be used to identify the use of water, energy, and other environmental resources, such as forests or land. The rank that you give to a particular aspect under this criterion is highly subject to the specific circumstances and values of your company and community. For example, a high rate of water use would be of higher concern in a desert region than in a region where water is more plentiful. This column allows you to consider what resource issues you might associate with a particular aspect. The rank you give is based on your judgment related to your own specific circumstances. Other natural resource issues include generation of solid waste and its contribution to landfills in your area. Worksheet 3-4 provides a place to document and rank these natural resource concerns. Place the rank from this worksheet in Worksheet 3-5.

### **L** Tip

Remember: The ranks have no intrinsic meaning. They are merely a shorthand for expressing your judgment about priorities.

#### Worksheet 3-4: Natural Resources Use

| Operation       | Aspect | Natural Resources Used | Rank |
|-----------------|--------|------------------------|------|
|                 |        |                        |      |
|                 |        |                        |      |
|                 |        |                        |      |
|                 |        |                        |      |
|                 |        |                        |      |
| Contact Person: |        | Date:                  |      |

## Overall Ranking and Significance

Review the columns for each aspect and make a judgment as to whether each aspect should be determined H, H-M, M, M-L, L in rank. After all the aspects have been given an overall rank, determine which of them you believe are significant for your company. Place a yes (Y) or no (N) in the final column.

## Ranking Environmental Aspects: Examples

The following example shows you how to rank the aspects identified in Module 1 using the criteria in Worksheets 3-5a and 3-5b. Examples of both small and large projects are included. It is important that you think through even solutions that seem obvious, because sometimes you might find a better solution. Refer to Figure 1-h and Worksheet 1-5 to refresh your memory on this example.

## Example 1: Toner Cartridges

*In this example, a copy machine is used to make paper copies as part of day-to-day business activities. The inputs are toner, paper, and electricity (energy) to run the copies. Outputs include spent toner cartridges, waste paper from poor quality copies, noise, and usable copies. There are no restrictions on use of the copier. Spent toner cartridges are simply discarded with the office trash.*

Let's consider the use of toner in copying. Unused toner is considered as an input, while used toner is considered as an output. The same product generates different concerns at different stages of its use. Let's look at the criteria for each in Worksheet 3-5a. The worksheet shows the aspects identified in Figure 1-h. Only the two toner input and output aspects are scored for this example, for illustration. However, in a real exercise, all the aspects would be scored.

**L Tip**

If you are pursuing ISO 14000 **certification**, you will have to address each significant aspect. You may want to consider reducing the number of significant aspects to two or three in the beginning and add more as your company grows in experience with the IEMS process.

### Worksheet 3-5a:<sup>a</sup> Criteria to Determine Significant Aspects—Toner Cartridge Example<sup>b</sup>

| Operation       | Aspect <sup>b</sup> | Regulatory Concerns | Chemical and Material Risk  |                                |                                  | Worker Safety | Other Community Issues: <sup>d</sup> | Natural Resources: <sup>e</sup> | Overall Ranking | Significant ?<br>Y/N |
|-----------------|---------------------|---------------------|-----------------------------|--------------------------------|----------------------------------|---------------|--------------------------------------|---------------------------------|-----------------|----------------------|
|                 |                     |                     | Worker Eff/Exp <sup>c</sup> | Community Eff/Exp <sup>c</sup> | Environment Eff/Exp <sup>c</sup> |               |                                      |                                 |                 |                      |
| Copying         | Paper Use           |                     |                             |                                |                                  |               |                                      |                                 |                 |                      |
|                 | Toner (Input)       | M                   | L/L                         | L/L                            | L/L                              | L             |                                      | L                               | M-L             | N                    |
|                 | Documents           |                     |                             |                                |                                  |               |                                      |                                 |                 |                      |
|                 | Waste Paper         |                     |                             |                                |                                  |               |                                      |                                 |                 |                      |
|                 | Used toner (Out)    | M-H                 | L/L                         | L/L                            | H/H                              | L             |                                      | M-H                             | M-H             | Y                    |
|                 | Odors               |                     |                             |                                |                                  |               |                                      |                                 |                 |                      |
| Contact Person: |                     |                     |                             |                                | Date Completed:                  |               |                                      |                                 |                 |                      |

<sup>a</sup> Corresponds to SEA-01 in *Company Manual Template*.

<sup>b</sup> Include each input and output of a process step.

<sup>c</sup> Effects/Exposure

<sup>d</sup> Noise, Traffic, Light, Odor.

<sup>e</sup> Include such items as Resource Use, Solid Waste, Energy Use

#### Ranking Notes for this Example:

Regulatory concerns may be present due to the chemicals used inside the cartridge or due to solid or hazardous waste regulations.

Effects of Chemicals and Materials inside the toner cartridge are probably of concern. You would have identified these in Module 1.

However, since the cartridges are not opened either during input or output use, there would be no exposure. Frequency of impact, therefore, would be low.

Workers: Worker health and safety would be of low or no concern if the toner is used only in the cartridges.

Community: The community's health and safety would be of low or no concern if the toner is used only in the

Environment might be high if you do not currently recycle your cartridges. Chemicals can spill out of the cartridges if they are placed in a landfill.

Natural Resource Use would be low for water, but might be a concern for land if you do not recycle the used cartridge.

**How to Obtain Overall Rank:** this can be done in two ways.

1. Look across the columns and assign a total that in your judgement best reflects the individual ranks in each column.
2. Assign a number from 1-5 to each rank such that H = 5 and L = 1. Sum these across the columns and then divide by the number of columns used to get an average rank for that row. For toner input the total would be 11 (counting each risk column as 2 because they have two scores and disregarding other community issues because it was not applicable). Divide by 9 (the number of columns used). The average rank would be 1.2, which corresponds with M-L. Place M-L in the Total column.

**Meaning of Environmental Aspects Rank:** The total rank for toner used as an input is M-L and for used toner as an output is M-H. These ranks tell you that toner cartridges as waste outputs of your copying generate more concern than they do as new inputs. Your main concern would be to reduce any potential impact of the used toner cartridges. You could reduce potential impact in at least three ways:

- < ensure that the cartridges are not opened either before or after use, to avoid exposure to the chemicals;
- < ensure that the cartridges are recycled according to the distributor's instructions, so that there is neither concern for ecological exposure to the chemicals in landfills, nor a contribution to the solid waste going into landfills; and
- < reduce the number of waste toner cartridges by cutting down on unnecessary copying.

Example 2: Chemical Use and Waste

*A second example will provide more points to consider in developing objectives. Consider the chemical inputs and the chemical waste outputs of a "Press Cleaning" example. In this example, a printer uses a chemical press cleaner (solvent*

### **L Tip**

Refer to Figure 1-i and Worksheet 1-5 to refresh your memory on this example.

*mixture) to manually clean the press after each print run. An uncovered bucket of cleaner is kept at press-side along with a bin of clean, cloth wipers and an uncovered container of soiled wipers. To clean the press, the printer scrapes excess ink from the press for reuse, dips one or more wipers in the press cleaner and wipes the press; wipes the press with one or more clean, dry wipers; and places soiled wipers in an open bin. Soiled wipers are transferred to a closed storage container at the end of the shift. Most of the resulting ink/solvent mixture is contained on the wipers, but excess is captured in drums and disposed of as a hazardous waste. Soiled wipers are sent to the laundry weekly.*

Thus, the inputs are the press cleaner and clean wipers. Outputs are reusable ink, soiled wipers, and waste ink/solvent mixture. The environmental aspects include the waste ink/solvent mixture and air and water emissions of press cleaner. Air emissions of press cleaner occur both in the print shop (from the uncovered bucket of cleaner, the cleaning operation itself, and the storage container of soiled wipers), and at the laundry (from the soiled wipers). We will score the two aspects of chemicals used in press cleaning and waste from those chemicals.

### Worksheet 3-5b:<sup>a</sup> Criteria to Determine Significant Aspects—Chemical Use and Waste Example<sup>b</sup>

| Operation       | Aspect <sup>b</sup>         | Regulatory Concerns | Chemical and Material Risk  |                                |                                  | Worker Safety | Other Community Issues: <sup>d</sup> | Natural Resources <sup>e</sup> | Overall Ranking | Significant? Y/N |
|-----------------|-----------------------------|---------------------|-----------------------------|--------------------------------|----------------------------------|---------------|--------------------------------------|--------------------------------|-----------------|------------------|
|                 |                             |                     | Worker Eff/Exp <sup>c</sup> | Community Eff/Exp <sup>c</sup> | Environment Eff/Exp <sup>c</sup> |               |                                      |                                |                 |                  |
| Press Cleaning  | Step 1                      |                     |                             |                                |                                  |               |                                      |                                |                 |                  |
| (in)            | Toxic chemical constituents | M-H                 | M/ M-H                      | M/ M-L                         | M/ M-L                           | M-L           | n/a                                  | M-H                            | M               |                  |
|                 | Wipers                      |                     |                             |                                |                                  |               |                                      |                                |                 |                  |
|                 | Energy                      |                     |                             |                                |                                  |               |                                      |                                |                 |                  |
|                 | Water                       |                     |                             |                                |                                  |               |                                      |                                |                 |                  |
| (out)           | Waste chemicals             | M-H                 | M/ M-H                      | M/ H                           | M/ H                             | M-L           | n/a                                  | M-H                            | M-H             |                  |
|                 | Soiled Wipers               |                     |                             |                                |                                  |               |                                      |                                |                 |                  |
|                 | Waste Water                 |                     |                             |                                |                                  |               |                                      |                                |                 |                  |
|                 | Air Releases #1             |                     |                             |                                |                                  |               |                                      |                                |                 |                  |
|                 | Product for next step       |                     |                             |                                |                                  |               |                                      |                                |                 |                  |
| Contact Person: |                             |                     |                             |                                | Date Completed:                  |               |                                      |                                |                 |                  |

<sup>a</sup> Corresponds to SEA-01 in *Company Manual Template*.

<sup>b</sup> Include each input and output of a process step.

<sup>c</sup> effects/exposure

<sup>d</sup> Include noise, traffic, light, odor.

<sup>e</sup> Include such items as resource use, solid waste, energy use.

#### Ranking Notes:

**Regulatory Concerns:** check the lists of regulations and standards to see if they apply to any of the chemicals you have identified as inputs. For outputs from your manufacturing process, find out whether the regulations for solid and hazardous waste make mention of these chemicals. Consider whether new chemical products are formed and become wastes during the process of step 1. If so, don't forget to check for these chemicals as well as the input chemicals. **Chemical and Material Risk:** Assign the ranks from your Effects and Exposure Worksheets. **Safety** might include reference to a flammable chemical. Hence the rank of M-L. **Natural Resource Use** may be important for both input and output chemicals. Also, consider the quantity of water used as an input or to take care of waste.

### Meaning of Rank

The total for input chemicals is M and M-H for output (waste). If you compare all the ranks, it would seem that the waste chemicals in this example, using assumed criteria, constitutes a more significant concern than do the other activities.

### Grouping Environmental Aspects

In reviewing your company's list of environmental aspects you may discover that some aspects occur in more than one process step. Energy use is a good example. It might be effective in some circumstances to combine all the process steps having energy aspects, and develop a facility-wide strategy and program for achieving improvement. Understand, however, that the energy aspect should be ranked in each process step to determine its relative importance in that step. For example, energy use in office work might be a different priority than energy use in a manufacturing step. In addition, standards and procedures developed to reduce energy use would be different for each process step. Consequently, although you might achieve certain efficiencies through a facility-wide effort, your actual environmental improvement will be attained through objectives set for each process step.

### Consider "Practical" Criteria Also

In order to determine which significant environmental aspects will become projects, it is important to consider the economic and technical feasibility and the time frame for your company. It is also important to consider what improvements could be expected from each project. Selecting high-priority projects is desirable from an environmental perspective, but there is value in undertaking some short term, "easier to implement" projects which may not be ranked high in environmental risk. The easier projects provide a useful learning experience, boost confidence as people see results, and focus attention on environmental goals.

### **L** Tip

You do not have to evaluate alternatives for all significant environmental aspects. Therefore, it is important to consider the "do-ability" of each project and to determine what improvements might be achieved by each project before deciding which ones to undertake.

### **L** Tip

Remember: If your company is considering ISO certification, you will have to demonstrate action on every SEA.

In the examples above, deciding to reduce the volume of copying and to recycle toner cartridges used in your office copier is a relatively short-term, low-cost environmental project to set in place as shown in Worksheet 3-6. Determining how to deal with chemical waste products could be a longer process: the obvious solution may not be the best, and a project that appears difficult and long-term may turn out to have a simple solution. The many alternative approaches to dealing with waste products can range from chemical substitutions to changing the nature of the wastes, changing work practices to reduce the volume of the waste, and changing disposal methods. Your final environmental program might include changes in each of these phases. In the example, although ink wastes may have the highest environmental risk rank, addressing those problems could be longer-term and more costly. On the other hand, doing so might yield greater cost savings than the quicker, cheaper toner cartridge example.

You need not rank your practical criteria; you can consider them by simply describing the practical considerations for each potential project. Worksheet 3-6 helps you lay out the considerations for each significant environmental aspect. At this point the worksheet provides you with a “first cut” qualitative judgment, to help choose aspects for further work. Aspects not selected at this time may be suitable for future projects.

| Worksheet 3-6: Criteria to Select Environmental Projects |                   |                                     |                                 |                   |
|--|-------------------|-------------------------------------|---------------------------------|-------------------|
| Project to Address Aspect                                | Time Frame        | Cost                                | Technical Feasibility           | Total Feasibility |
| Toner (In)   | N/A               | N/A                                 | N/A                             | N/A               |
| Used Toner (Out)   | Short (1 month)   | Negligible; time to write procedure | Easy                            | Excellent         |
| Press cleaner (In)                                       | Longer evaluation | Employee time                       | Needs help from suppliers, etc. | More difficult    |
| Waste Ink (Out)<br>Soiled Wipers (Out)                   | Longer evaluation | Employee time, process change       | Needs help from suppliers, etc. | More difficult    |
| Contact Person:  |                   |                                     | Date Completed:                 |                   |

Finally, compare in general the expected improvements to be gained by working on each aspect. Like any undertaking in a business operation, you should be able to describe what you expect to get before you undertake the project! First, develop a list of benefits criteria. These might include such things as:

- < Reduced human health impacts
- < Reduced environmental impacts
- < Cost savings
- < Improved community relations
- < Improved employee morale
- < Customer benefit

Again, these particular criteria might not fit your company. Make a list of criteria identifying kinds of improvements that could be derived from undertaking environmental projects. These expected improvements need not be ranked; simply describe the potential for each criterion to be achieved. Worksheet 3-7 illustrates the two examples.

### **L** Tip

Considering the benefits does not mean undertaking an analysis of potential outcomes. It means identifying the kinds of improvements that might be achieved by implementing a particular project and then deciding what value (priority) that improvement has for your company.

| Worksheet 3-7: Potential Improvements                        |   |  |  |                     |                     |                       |
|--|---|--|--|---------------------|---------------------|-----------------------|
| Aspect   | Human Health <sup>1</sup>                                 | Environment                                      | Cost Savings                                   | Community Relations | Morale              | Expected Improvements |
| Toner (In)   | Little effect   | Little   | Low  | N/A                 | N/A                 | N/A                   |
| Used Toner (Out)   | Some effect through waste                                 | Some effect in waste                             | Some   | Good; shows effort  | Good learning tool  | Some                  |
| Press Cleaner (In)   | Improve worker health                                     | Some improve, air                                | Some through efficiency                        | Good                | Good; workers happy | Good                  |
| Waste Ink (Out)<br>Press Cleaner (In)<br>Soiled Wipers (Out) | Improve community; reduce presence of hazardous materials | Improve effect on landfill, groundwater, habitat | Some through efficiency and reduced waste fees | Excellent PR        | Good; workers happy | Excellent             |
| Contact Person:  |   |  |  |                     | Date Completed:     |                       |

<sup>1</sup> Workers, Community, Global

## Overall Summary of Ranking

Worksheet 3-8 illustrates how to put together the results from ranking the significant environmental aspects with the results from the economic, technical and improvements worksheets so that you can determine which will make the best projects for your company at this time. Projects not chosen now can be developed later. The example illustrates that while chemical waste may present one of the most involved projects in terms of feasibility, it may also provide the greatest improvements. The final decision rests with your company and should reflect both your values and your needs. You may want to undertake both a short-term and a long-term project.

### Tip

It is important to recognize that the tables are merely a tool to help you summarize your judgment and organize your thoughts. The ranks placed in the tables do not have any intrinsic value but are used for purposes of comparing the results to each other.

| Worksheet 3-8: Overall Ranking Summary |                 |                      |                   |                    |
|--|-----------------|----------------------|-------------------|--------------------|
| Process Step<br>Aspect                 | Aspect<br>Total | Feasibility<br>Total | Benefits<br>Total | Significant<br>Y/N |
| Toner (In)                             | M-L             | N/A                  | N/A               |                    |
| Used Toner                             | M-H             | H                    | M                 | N                  |
| Chemicals                              | M               | M-L                  | M-H               |                    |
| Chemical<br>Waste                      | H               | M-L                  | H                 | Y                  |
| Contact Person:                        |                 |                      | Date Completed:   |                    |

## Setting Objectives

The point of the priority setting exercises, of course, is to reduce your company's impact on the environment. The process outlined in this Guide describes two approaches: making your current activities and processes the best they can be and making significant changes in the products your company uses or produces, and in the processes or activities of your company. If you intend to seek ISO 14000 certification, you will need to take action on each SEA identified. If you are not seeking

certification, you can be more flexible in undertaking projects.

Module 4 describes the process of evaluating alternatives for those SEAs you believe will require changes. Module 6 describes the process of developing operational controls for the SEAs that will not involve significant changes at this time. (You may decide to evaluate alternatives and make changes in these later.)

At this point, general objectives can be developed for each SEA identified. These objectives should be consistent with your company's environmental policy and also with your company's compliance requirements. Using the examples ranked on the worksheets above, a company could specify its objectives as follows:

- < Reduce the waste from used toner cartridges.
- < Reduce the environmental impact of press cleaning.

These objectives state the desired outcome in terms of the desired improvement in environmental impact, not in terms of the specifics of how it might be accomplished. For example, the objective of reducing waste from toner cartridges is open as to how that might be accomplished. One could reduce the use of toner cartridges, ensure that the recycling program is adhered to, or stop using copiers and printers that have toner cartridges in favor of another technology. Likewise, reducing impact from the press cleaning process can be accomplished in different ways.

In looking at these two objectives, one might note that the toner cartridge objective might be met by writing and posting a **procedure** that ensures recycling of the cartridges and by making sure that people who change the toner cartridges have sufficient *training* in this procedure. On the other hand determining how to reduce the impact of chemical wastes may involve some greater changes that would be provided by operational controls and

training *alone*. In this case, an **alternatives evaluation** would be necessary. After an alternative is identified, of course, operational controls and training would be needed for the new product, process or activity.

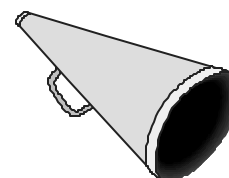
It is important to take on what you can finish. In the beginning, tackle the SEAs that you can handle, what is environmentally important, and whatever is urgent. Your company can start on any remaining SEAs when you have completed the first ones.

## MODULE 4: EVALUATING ALTERNATIVES

In this module we explore ways to evaluate alternatives for environmental aspects that you want to change. In Module 6 we will review how to write and implement operational controls for significant aspects where you are not evaluating alternatives. As examples of alternatives evaluations, we will show one project having a quick, low-cost solution and one requiring greater analysis and longer-term implementation: the examples of toner cartridges and press cleaning chemicals. The objectives from the end of Module 3 were as follows:

- < Reduce the waste from used toner cartridges.
- < Reduce the environmental impact of chemical wastes from press cleaning. The environmental aspect is vapors released to air during the press cleaning process and at the industrial laundry where used press wipers are sent. Identification of this significant aspect occurred when the laundry called the company and said they had received complaints from the local regulatory agency regarding solvent traced to the printer's press cleaning wipers. The information for this example comes from the DfE Program Lithography Case Study 1. (See DfE Program website for Case Study.)

This module will help you determine how to work toward the objectives you selected in Module 3. In some cases, this might not be a difficult process. In others, however, the solution might



Screenprinters in the SGIA IEMS Pilot Project had this to say about the DfE method:

"The DfE method forces one to evaluate all aspects—health, safety, regulatory, environmental. The method helps you to make informed decisions.

"The process standardizes methods used to assess risk and resource efficiency. It makes it easier to compare "apples to apples." While some matters are still judgement calls, having a frame of reference to work within ensures that the standards used to make those

The DfE Program emphasizes the importance of evaluating an array of alternatives before determining appropriate action. The best solution may not be the most obvious and risk reduction, like pollution prevention, may save you money.



solution might not be obvious. For example, you may have identified the waste from the use of a chemical as a significant aspect and determined that alternative practices exist. You may have then set an objective of reducing the environmental impact from that chemical as it is used in your business processes. One alternative way to achieve that objective would be to target that chemical for replacement, but that may not be the best solution for your company. It is important, therefore, to consider other options for managing the environmental impact of that chemical as it is used by your company, as well as the option of replacement. This module will walk you through a process of evaluating options for substitution. It will also help you develop achievable targets having both environmental and economic advantages.

### Step 1: Define the Baseline

The baseline is your current chemical, activity or technology that is the source of the environmental aspect. The process map you developed in Module 1 is a convenient tool for defining boundaries of the baseline.

Usually it is fairly straightforward to determine at what point in the overall process the baseline begins and ends. The definition can make a big difference, however, in the scope of an alternatives evaluation and in the variety of alternatives examined. In our press cleaning example above, the baseline could be defined in different ways, depending on exactly how the environmental aspect is specified. If one identifies the environmental aspect as vapors contaminating the work area,

then the baseline would be use of the product producing the vapors and whatever ventilation hoods or personal protective equipment are used. If, however, the environmental aspect is identified as the regulated chemical discharges from the laundry when washing the press wipers, then the baseline becomes the chemical product used to clean presses and the work practices that leave large quantities of the solvent in the press wipers when they are sent to the laundry. In the first case, alternatives might include different chemical cleaning products and also different kinds of ventilation equipment and personal protective equipment. In the second case, alternatives would include products, work practices and methods of reducing solvent left in used wipers. Be sure to capture all you need when you define your baseline.

## Step 2: Identify the Function

Next, define the function of the activity with which the significant environmental aspect is associated. Defining the function helps to broaden your perspective in developing alternatives because it allows you to step back from that specific part of the process and think holistically about how things might be done differently. Looking at earlier parts of the process will inform you about potential alternative practices. Defining the function often opens up opportunities that may be missed by focusing only on the process step. Here are two examples:

### Example 1

**Aspect identified:** Waste from toner cartridges used in copier.

**Baseline:** Day-to-day copying activities in an office

## Internet Help



Visit the DfE website for more tools related to evaluating alternatives.

[www.epa.gov/dfe](http://www.epa.gov/dfe)

environment with no restrictions on use of the copier. Spent toner cartridges are discarded with office trash.

**Function of toner cartridges:** to deliver the chemicals to make clear copies.

#### Example 2

**Aspect identified:** air and water emissions from solvent used for press cleaning.

**Baseline:** Manual cleaning of press using a chemical press cleaner (a blend of acetone, toluene, methyl ethyl ketone, and isopropyl alcohol) and cloth wipers to wipe down the press, with no restrictions on the amount of cleaner or number of wipers used. Chemicals and soiled wipers are kept in uncovered containers during the work day and closed containers after work hours. Waste ink/solvent mixture is collected in drums and disposed of as hazardous waste. Wipers are collected and sent to laundry.

**Function of press wash:** to ensure good quality printing by thoroughly cleaning the press during and after the printing process.

### Step 3: Develop a List of Alternatives

The important question to ask is how this function could be accomplished in other ways that might prove to be environmentally preferable, while still meeting cost and performance concerns. Different levels and kinds of alternatives should be considered. For example:

<      Substitute products

- < Reduce product use, through technology changes and improved work practices
- < Improve treatment technologies
- < Improve disposal technologies

Example 1: List the alternatives for reducing the waste from used toner cartridges

- < First, are there substitute products that could be used in place of toner cartridges? Probably not, given current technology and the fact that the toner cartridge specifications are required by the make and model of the printer.
- < Is there a way to reduce the use of the toner cartridges, thereby reducing the waste product? By defining copier needs, the quantity of copying could possibly be reduced by encouraging the use of electronic transfer of information within the company, in place of distributing paper copies.
- < Improved treatment technologies — does not apply for this example.
- < Improved disposal technologies. The disposal alternatives include throwing in the trash or recycling.

Example 2: List the alternatives to the current press wash process

- < Substitution: First ask the question, is there any way to achieve the required product quality with the use of less or no press cleaning solution? You may consider substitutions in another part of the process, such as the type of ink, so that less or different press cleaning

solution could be used. Or, you could also consider substituting the press wash solution for a less volatile cleaner.<sup>1</sup> Such substitution may require other process changes to work. You could also consider using disposable cleaning wipers, which would eliminate the releases and exposures at the laundry. In doing so, however, you may create a problem of hazardous waste at the landfill, thereby merely transferring the problem from one location to another rather than solving it.

- < Reducing use of the product: reduction in use of the press wash solution might be brought about by scheduling jobs to require less cleaning (e.g., heavy coverage jobs *after* light coverage; dark colors *after* light colors), or by implementing inventory control procedures that discourage operators from using more wash than necessary (e.g., by limiting the amount of wash kept at press-side). In addition, a study could be made to determine what methods are used by press operators who use the least solvent. Their methods could be used to train others.
- < Responsible recycling/reuse: Possibly the waste press wash solution could be reused one or more times; if not on the press, then in other clean-up applications.
- < Improved treatment technologies: Soiled wipers can be run through a centrifuge to capture excess solvent prior to being sent to the laundry, but fire regulations should be consulted to ensure this doesn't impose a fire hazard.

### **L Tip**

Think broadly when developing alternatives. Sometimes an alternative that is upstream or downstream from your process will produce better results than will a change of chemicals or another in-process change.

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<sup>1</sup>“Volatile” means that the substance evaporates easily.

- < Improved disposal technologies: What are alternatives for disposal? Sending the wipers to the laundry; extracting waste solvent from the wipers and reusing the solvent for other cleaning jobs, then sending it to be burned as a fuel; using disposable wipers and throwing them in the trash.

Worksheet 4-1 will help you organize the functions and alternatives for your evaluation. Create your own worksheet from the significant environmental objectives you selected in Module 3. Some of these boxes can be filled out by brainstorming within the team working on the IEMS, but some will require further work before they can be completed. Some additional sources of information include chemical product suppliers, machinery manufacturers and suppliers, workers on the line, trade associations, technical magazines associated with your business, or other businesses like yours. You may be surprised at how much information you will uncover. One way to proceed might be to assign each member of the team one area of information to collect, and then have them use it to fill in the chart at the next team meeting. It's important to collect as many ideas as possible and then narrow down your list of alternatives to evaluate. By keeping your mind open in your initial brainstorming you may uncover worthwhile alternatives that are not obvious.

## Worksheet 4-1:\* Potential Alternatives

**Significant Environmental Aspect:** Waste toner cartridges

**Baseline:** Spent toner cartridges are discarded in trash.

**Function:** Provide ink for duplicating

|                     | Current Practices         | Potential Alternatives   |
|---------------------|---------------------------|--|
| Products            | Toner Cartridges          | N/A  |
| Technologies        | Paper                     | More electronic media use would reduce need for toner cartridges         |
| Work Practices      | Unlimited copier use      | More careful about use of printing could reduce quantity of toner needed |
| Recycling/<br>Reuse | Discard in trash          | Follow manufacturer's directions to recycle                              |
| Treatment           | N/A                       | N/A  |
| Disposal            | See Recycling/Reuse Above | See Recycling/Reuse Above  |
| Contact Person:     |                           | Date Completed:  |

\* Document these results in Section AE of the *Company Manual Template*.

## Worksheet 4-1:\* Potential Alternatives

**Significant Environmental Aspect:** Press washing

**Baseline:** Manual cleaning of press using a chemical press cleaner (a blend of acetone, toluene, methyl ethyl ketone, and isopropyl alcohol) and cloth wipers to wipe down the press, with no restrictions on the amount of cleaner or number of wipers used. Chemicals and soiled wipers are kept in uncovered containers during the work day and closed containers during after hours. Waste ink/solvent mixture is collected in drums and disposed of as hazardous waste. Wipers are collected and sent to laundry.

**Function:** Provide crisp print quality by effectively cleaning press.

|                 | Current Practices                                 | Potential Alternatives                                     |
|-----------------|---|--|
| Products        | Prod. A (current)                                 | Prod. B<br>Prod. C<br>(Special formulation)                |
| Technologies    | Current blankets,<br>Cloth wipers,<br>Current ink | Different blankets;<br>Disposable wipers;<br>Different ink |
| Work Practices  | Work Practice A                                   | Work Practice B<br>Work Practice C                         |
| Recycling/Reuse | Leave solvent in wipers                           | Reuse of solvent for other clean up.                       |
| Treatment       | Leave solvent in wipers                           | Extraction of solvent from wipers                          |
| Disposal        | Laundry   | Trash<br>Drain<br>Hazardous Waste                          |
| Contact Person: |   | Date Completed:  |

\* Document these results in Section AE of the *Company Manual Template*.

## Step 4: Set the Scope of the Evaluation

You have now reached a critical decision point in your evaluation of alternatives. You must decide how detailed an evaluation is feasible. Keep in mind the cost of performance testing as you choose alternatives to evaluate.

When you have selected alternatives to evaluate, place these alternatives in the appropriate parts of your process map developed in Module 1. If necessary, create new segments of the process map so that you can show how the alternative fits into your process.

The following worksheets show the kinds of information that should be collected for each set of alternatives to yield a decision about which option would be the most feasible, both technically and economically, for your company to reduce its environmental impact. These tables will also give you the information needed to frame specific measurable targets for your environmental programs.

Each alternative requires developing several kinds of information:

- < health,
- < safety,
- < environmental effects,
- < performance capabilities,
- < cost,
- < effects on resource use, and
- < regulatory concerns.

This information will help you integrate human health and

environmental concerns into your usual decision-making criteria of performance and cost. The following worksheets are designed to help you organize this information in a way that makes comparisons easier. The following sections take you step by step through the evaluation process.

#### Example 1

To develop alternatives on copier toner cartridges, your company would conduct brainstorming sessions about the options for more use of electronic media within your office and otherwise reducing the need to use the copier in your office activities. Developing ways to cut down on copying can extend the life of toner cartridges and reduce the volume requiring disposal. Steps that seem appropriate and desirable can be recorded and incorporated into your targets. You could establish a dual goal of reducing the volume of copying and 100% recycling of toner cartridges.

Module 6 explains how to develop operational controls to ensure reduced environmental impact. Module 7 explains how you can make your goals into an “environmental project.”

Most of the alternatives for Example 1 do not require substantial changes and would be implemented by designing guidelines for use and maintenance of the copier, i.e., operational controls. While these alternatives could be evaluated using the steps below, we will not include this example in the sample worksheets. Example 2 provides a more thorough example of the evaluation process, and we will focus on that.

## Example 2

To develop alternatives to reduce air and water emissions caused by press washing, a full evaluation would require research for each of the alternatives identified. (You may view such an extensive analysis on the DfE Website. See Appendix G.) You may not have the resources to do a full evaluation at this time, but you can research any of the alternatives you choose. The point of identifying a range of alternatives is to let you choose the options to evaluate with full knowledge of the range available to you, rather than in response to preconceptions. For example, you could choose to evaluate one set of alternatives now and another set at a later date as part of a continuing effort.

### Step 5: Evaluate Potential Human Health and Environmental Effects of Alternatives <sup>2</sup>

Worksheet 4-2 through 4-6 shows the kind of information needed to evaluate the environmental effects of alternative products.

Refer to Module 3 for explanation of the elements. Worksheets 4-2 through 4-6 correspond to worksheets 3-1 through 3-5 in Module 3.

#### **L** Tip

The worksheets presented in this section are designed to be “one-size-fits-all.” Unfortunately, not all evaluations will be the “same size.” Adapt these worksheets to suit the needs of your evaluation.

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<sup>2</sup>All information in worksheets is created for purposes of illustration and does not represent real data.

## Worksheet 4-2:<sup>a</sup> Alternatives Evaluation: Health, Safety and Environmental Potential Effects Information

Baseline: Manual cleaning of press using a chemical press cleaner (a blend of acetone, toluene, methyl ethyl ketone, and isopropyl alcohol) and cloth wipers to wipe down the press, with no restrictions on the amount of cleaner or number of wipers used. Chemicals and soiled wipers are kept in uncovered containers during the work day and closed containers during after hours. Waste ink/solvent mixture is collected in drums and disposed of as hazardous waste. Wipers are collected and sent to laundry.

Significant Environmental Aspect: Press cleaning

| Alternative                      | Information Sources | Regulatory Data: <sup>b</sup><br>Carcinogen?<br>OSHA Exposure limit? Volatile Organic Compound (VOC)?<br>Toxics Release Inventory (TRI)? | Human Health Effects by Pathways<br>Acute and Chronic <sup>c</sup> |                      |      | Comments | Effects on Wildlife and Other Environmental Effects <sup>d</sup> |       |      | Worker Safety <sup>e</sup>   | Rank               |     |
|----------------------------------|---------------------|--|--|----------------------|------|----------|--|-------|------|--|--------------------|-----|
|                                  |                     |  | Inhalation   | Dermal               | Oral |          | Air  | Water | Land |  | Human <sup>f</sup> | Env |
| Products<br>Baseline:<br>Blend A | MSDS                | Greater than 50% VOC — all chemicals in blend  |  |                      |      |          |  |       |      |  |                    |     |
| acetone 25%                      |                     | OSHA PEL, 8H TWA: 1000 ppm, burn in chemical incinerator, EPA FIFRA pesticide, Calif Prop 65<br>Repro Haz                                | irritant, liver, kidney,   | irritant, eye damage |      |          | may contribute to smog   | ?     | ?    | highly flammable, vapor may flash back, explosive, combustive, may produce carbon monoxide or carbon dioxide | H                  | ?   |

|                                  |                         |  |  |   |   |   |                        |                     |   |   |     |   |
|----------------------------------|-------------------------|--|--|---|---|---|------------------------|---------------------|---|---|-----|---|
| toluene 25%                      |                         | Burn in incinerator, OSHA PEL 8H TWA 200 ppm, SARA 313 reporting, Calif Prop 65 developmental toxicity       | toxic, liver, kidney, destructive to tissues, lung irritation, chest pain, edema, possibly fatal, abortion, changes in bone marrow | toxic, extremely irritating             | toxic   | Effects may be increased by alcohol consumption | may contribute to smog | ?                   | ? | Highly flammable, combustive, protect from moisture                 | H   | ? |
| MEK 25%                          |                         | burn in chemical incinerator, EPA FIFRA pesticide, OSHA PEL 8H TWA 200 ppm, TSCA 8a rule, SARA 313 reporting | irritant respiratory system, central nervous system depression, nausea, dizziness, headache, gastro-intestinal, narcotic effect    | irritant eyes, skin, dermatitis         |   |   | may contribute to smog | ?                   | ? | Highly flammable, combustive, protect from moisture                 | M-H | ? |
| isopropyl alcohol 25%            |                         | may be disposal regulations  | irritant nose & throat, central nervous system depression, vomiting, headache, coma, death   | irritant eye, corneal burns, dermatitis | large amounts: headache, nausea, vomiting, unconsciousness, death |   | may contribute to smog | ?                   | ? | Flammable, reactive, may produce carbon monoxide and carbon dioxide | H   | ? |
| Special blend B: vegetable ester | DfE Lithography Project | Less than 30% vocs<br><br>No regulations   | Low  | Low                                     | Low   |   | ?                      | no aquatic toxicity | ? | No concerns   | L   | L |

|   |                                       |   |                 |                 |                 |                 |                 |                 |                 |   |   |   |
|---|---------------------------------------|---|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|---|---|---|
| Technologies  |                                       |   |                 |                 |                 |                 |                 |                 |                 |   |   |   |
| Work Practices  |                                       |   |                 |                 |                 |                 |                 |                 |                 |   |   |   |
| Recycling/ Reuse  |                                       |   |                 |                 |                 |                 |                 |                 |                 |   |   |   |
| Treatment Centrifuge used to extract solvent from wipers, using Blend A | DfE Lithography Project, Case Study 1 | Possible regulation about using centrifuge, all other regulations applying to Blend A above | Same as Blend A | Same as Blend A | Same as Blend A | Same as Blend A | Same as Blend A | Same as Blend A | Same as Blend A | Same as Blend A, also will need an explosion proof centrifuge | H | H |
| Disposal  |                                       |   |                 |                 |                 |                 |                 |                 |                 |   |   |   |
| Contact Person:   |                                       |   | Date Completed: |                 |                 |                 |                 |                 |                 |   |   |   |

## MODULE 4: EVALUATING ALTERNATIVES

a See Section AE of the *Company Manual Template*.

b Most Information for this column can be found on the MSDS.

c Partial information for these columns might come from the MSDS, but other resources may be needed. In particular, acute effects are usually reported on MSDS sheets. Chronic effects are sometimes on MSDS sheets, but often will have to be found elsewhere.

d MSDSs usually do not include environmental effects.

e There may be information on the MSDS that would be useful for preparing your emergency preparedness plan.

f This rank is based on the potential effects of the chemical and not on the dose required to obtain those effects. For example, a person can drink a certain amount of Scotch. Drinking a large quantity of Scotch, however, can be lethal. Therefore dose does make a difference ultimately in making a judgment. However, one can still make a qualitative ranking about whether Scotch, cola, water, milk or juice have beneficial or negative impacts. For more discussion of the role of "dose" see the Hazard Guide on the DfE web site.

Note: For more information on risk related data, including methods for interpreting quantitative toxicity values, refer to the risk Guide provided on the DfE Program website. The data on this table were constructed for purposes of illustration and do not represent real data.

### Worksheet 4-3: Alternatives Evaluation: Exposure to Chemicals and Materials

**Baseline:** Manual cleaning of press using a chemical press cleaner (a blend of acetone, toluene, methyl ethyl ketone, and isopropyl alcohol) and cloth wipers to wipe down the press, with no restrictions on the amount of cleaner or number of wipers used. Chemicals and soiled wipers are kept in uncovered containers during the work day and closed containers during after hours. Waste ink/solvent mixture is collected in drums and disposed of as hazardous waste. Wipers are collected and sent to laundry.

**Significant Environmental Aspect:** Press cleaning

| Alternative Products | Quantity*<br>Used per time period       | Exposure Time  |                                    | Personal Protective Equipment (PPE)  | Pathway   |                                  | Rank Exposed Groups |                            |             |
|----------------------|---|--|------------------------------------|--|---|----------------------------------|---------------------|----------------------------|-------------|
|                      |   | Duration**   | Frequency                          |  | Human:<br>Inhalation, Dermal, Oral              | Environment:<br>air, water, land | Workers             | Community                  | Environment |
| Baseline:<br>blend A | 24 oz. Per day<br>for cleaning<br>press | 10 min. for<br>cleaning<br><br>all day for<br>wipers in open<br>bins | 5 times per<br>day for<br>cleaning |  |   |                                  | H w/o PPE           | H<br>(laundry<br>releases) | M           |
| acetone              |   |  |                                    | face shield, chemical<br>safety goggles, chemical<br>gloves, mechanical<br>exhaust, NIOSH-OSHA<br>respirator | All for workers,<br>inhalation for<br>community |                                  |                     |                            |             |
| toluene              | Same                                    | same   | same                               | above, plus chemical<br>fume hood  | All for workers,<br>inhalation for<br>community | air, water                       |                     |                            |             |
| MEK                  | same                                    | same   | same                               | same as acetone  | All for workers,<br>inhalation for<br>community | air, water                       |                     |                            |             |

|  |   |   |                              |   |   |            |  |   |   |
|--|---|---|------------------------------|---|---|------------|--|---|---|
| isopropyl alcohol                        | same  | same  | same                         | half mask respirator, gloves, local exhaust, safety goggles, rubber apron, boots, impervious clothing | All for workers, inhalation for community | air, water |  |   |   |
| Blend B: vegetable ester                 | 12 oz per day for cleaning press                              | 10 min. for cleaning, all day for wipers in open bins | 5 times per day for cleaning | none  | all                                       | water      | M w/o PPE (less due to less volume used and less volatile mix) | M   | L |
|  |   |   |                              |   |   |            |  |   |   |
| Technologies                             |   |   |                              |   |   |            |  |   |   |
| Work Practices                           |   |   |                              |   |   |            |  |   |   |
| Recycling/Reuse                          |   |   |                              |   |   |            |  |   |   |
| Treatment: Centrifuge (assuming Blend A) | 8 oz recovered per day - reduce environmental releases by 1/3 | 10 min while putting wipers in centrifuge             | 1 time per day               | gloves  | inhalation, dermal                        | n/a        | M w/o PPE  | M (possibly some fumes from venting centrifuge) | L |
| Disposal                                 |   |   |                              |   |   |            |  |   |   |
| Contact Person:                          |   |   |                              |   | Date:                                     |            |  |   |   |

\*If ingredient in chemical product, use quantity of chemical not product, i.e., apply the percentage that the ingredient makes up of the product.

\*\*How many minutes or hours per day is the chemical or material used?

Note: All data are for purposes of illustration and do not represent real data.

### Worksheet: 4-4: Alternatives Evaluation: Community Issues

Significant Environmental Aspect: Press Cleaning

| Alternative     | Community Issues (List) | Rank  |
|-----------------|-------------------------|-------|
| Products        | no additional issues    |       |
| Technologies    |                         |       |
| Work Practices  |                         |       |
| Recycling/Reuse |                         |       |
| Treatment       |                         |       |
| Disposal        |                         |       |
| Contact Person: |                         | Date: |

### Worksheet: 4-5: Alternatives Evaluation: Natural Resource Use

Significant Environmental Aspect: Press Cleaning

| Alternative     | Natural Resources Used (List) | Rank  |
|-----------------|-------------------------------|-------|
| Products        | no additional issues          |       |
| Technologies    |                               |       |
| Work Practices  |                               |       |
| Recycling/Reuse |                               |       |
| Treatment       |                               |       |
| Disposal        |                               |       |
| Contact Person: |                               | Date: |

## Worksheet 4-6:<sup>a</sup> Alternatives Evaluation: Criteria to Determine Environmental Impact

**Baseline:** Manual cleaning of press using a chemical press cleaner (a blend of acetone, toluene, methyl ethyl ketone, and isopropyl alcohol) and cloth wipers to wipe down the press, with no restrictions on the amount of cleaner or number of wipers used. Chemicals and soiled wipers are kept in uncovered containers during the work day and closed containers during after hours. Waste ink/solvent mixture is collected in drums and disposed of as hazardous waste. Wipers are collected and sent to laundry.

**Significant Environmental Aspect:** Press Cleaning

| Alternative           | Regulatory Concerns | Chemical and Material Risk  |                                |                                  | Worker Safety | Other Community Issues: <sup>c</sup> | Natural Resources <sup>d</sup> | Overall Ranking | Preferred Alternative? Y/N |
|-----------------------|---------------------|-----------------------------|--------------------------------|----------------------------------|---------------|--------------------------------------|--------------------------------|-----------------|----------------------------|
|                       |                     | Worker Eff/Exp <sup>b</sup> | Community Eff/Exp <sup>b</sup> | Environment Eff/Exp <sup>b</sup> |               |                                      |                                |                 |                            |
| Products:             |                     |                             |                                |                                  |               |                                      |                                |                 |                            |
| Blend A (Baseline)    | H                   | H/H                         | H/H                            | ?/M                              | H             | n/a                                  | n/a                            | H               |                            |
| Blend B               | L                   | L/M                         | L/M                            | L/L                              | L             | n/a                                  | n/a                            | L               | yes                        |
| Technologies          |                     |                             |                                |                                  |               |                                      |                                |                 |                            |
| Work Practices        |                     |                             |                                |                                  |               |                                      |                                |                 |                            |
| Recycling/Reuse       |                     |                             |                                |                                  |               |                                      |                                |                 |                            |
| Treatment: Centrifuge | M                   | H/M                         | H/M                            | ?/L                              | H             | n/a                                  | n/a                            | M-L             | yes                        |
| Disposal              |                     |                             |                                |                                  |               |                                      |                                |                 |                            |
| Contact Person:       |                     |                             |                                | Date Completed:                  |               |                                      |                                |                 |                            |

<sup>a</sup> Corresponds to SEA-01 in *Company Manual Template*.

<sup>b</sup> Effects/exposure

<sup>c</sup> Noise, traffic, light, odor.

<sup>d</sup> Include such items as resource use, solid waste, energy use.

## Step 6: Evaluate the Performance of Alternatives

Evaluating the performance of your alternative chemical products requires several steps, as described below. Performance evaluations can be expensive to perform. Consider the cost of the evaluation when deciding how many and what kind of alternatives to test.

**Describe the baseline.** The baseline is the standard chemical, activity, or technology that is currently used. The baseline also includes the boundaries of the baseline, its process steps and how they are performed. This ensures that (1) a similar process is used to evaluate the performance of the baseline and alternatives where possible, or (2) when a different process is used due to the nature of the alternative (e.g. technology), differences will be noted and understood. The alternatives will then be compared to this baseline.

*Example:* The baseline for press washing is manual cleaning of press using a chemical press cleaner (a blend of acetone, toluene, methyl ethyl ketone, and isopropyl alcohol) and cloth wipers to wipe down the press, with no restrictions on the amount of cleaner or number of wipers used. Chemicals and soiled wipers are kept in uncovered containers during the work day and closed containers during after hours. Waste ink/solvent mixture is collected in drums and disposed of as hazardous waste. Wipers are collected and sent to laundry.

### **L** Tip

Cost data for your cost evaluation should be collected during the performance evaluation. There may be more uncertainty in the cost data if you wait to develop it until after the performance evaluation. See Step 8 for information on what kind of data will be needed for your cost evaluation.

**Identify the most important performance traits for the selected process area.** Some sample performance traits include the following: how well does it work, how long does it take, how easy is it to use, and how easy is it to install?

*Example:* The most important performance traits for press wash are that it work quickly to cut ink, require minimal wiping to remove any oily residue, dry quickly, and not adversely affect print quality.

**Determine how the alternatives will be compared with the baseline.** One example of a quantitative comparison is measuring the time it takes to complete a task. One example of a qualitative comparison is using a scale, such as ++ representing “much more favorable than the baseline.”

*Example:* We will use a comparison scale from -2 to +2, where -2 represented “much less favorable than the baseline,” +2 represented “much more favorable,” and a 0 represented “no difference with the baseline.”

**Select the operating conditions for testing the baseline and alternatives and conduct the evaluation.** The operating conditions should be realistic and consistent for the baseline and alternatives. If you cannot test an alternative at your facility (e.g., new equipment), have the supplier provide off-site service or performance test data. Conditions should be as similar as possible for each test, or the results will not be comparable. Examine work practices as well to ensure similar application from test to test. Other elements that may affect testing include room temperature and humidity. Make a list of

## L Tip

See Appendix C for sample performance evaluation worksheets from the DfE Printing Project.

what things might affect your test results and try to make sure that they are similar for each test.

*Example:* Evaluate the baseline and alternatives using the same size printing run, the most commonly used ink formulation, the same application procedures, and the same printed image.

An evaluation example is shown in Worksheet 4-7.

## Worksheet 4-7:\* Performance Comparison of Alternatives

Significant Environmental Aspect: press cleaning

Baseline: Manual cleaning of press using a chemical press cleaner (a blend of acetone, toluene, methyl ethyl ketone, and isopropyl alcohol) and cloth wipers to wipe down the press, with no restrictions on the amount of cleaner or number of wipers used. Chemicals and soiled wipers are kept in uncovered containers during the work day and closed containers during after hours. Waste ink/solvent mixture is collected in drums and disposed of as hazardous waste. Wipers are collected and sent to laundry.

Function: ensure crisp print quality by effectively cleaning press

|   | How well it works                                 | Time | Ease of use | Overall Performance Evaluation       |
|---|---|------|-------------|--------------------------------------|
| Blend A (baseline)                          | 0   | 0    | 0           | 0                                    |
| Product B                                   | 0<br>(Did not show much difference from baseline) | 0    | 0           | 0                                    |
| Technologies                                |   |      |             |                                      |
| Work Practices                              |   |      |             |                                      |
| Recycle/ Reuse                              |   |      |             |                                      |
| Treatment:<br>Centrifuge to recover Blend A | +   | “+”  | “+”         | “+”<br>works well to recover solvent |
| Disposal                                    |   |      |             |                                      |
| Contact person:                             |   |      |             | Date Completed:                      |

\*Document these results in Section AE of the *Company Manual Template*.

### Step 7: Evaluate what regulations may be triggered by using each alternative

For each alternative being considered, make sure you understand the applicable regulations. This may influence your choice of alternatives. Identify what management controls might be required by these regulations. Also consider what additional cost might be attributed to the regulation. Some of the costs associated with using a product or process may be attributable to a regulation triggered by using that product or process. These would be the regulatory cost and should be included on Worksheets 4-8 and 4-9.

| Worksheet 4-8:* Regulatory Comparison of Alternatives |                                 |                       |   |  |
|---|---------------------------------|-----------------------|---|--|
| Alternative   | Applicable Regulations          | Required Controls     | Regulatory Cost Items <sup>1</sup>                      | Overall Regulatory Concerns Evaluation |
| Product Blend A                                       | same as Worksheet 4-2           | same as Worksheet 4-3 | SARA reporting, PPE, Chemical fume hoods, fire controls | H                                      |
| Blend B   | none                            | none                  | none  | L                                      |
| Technologies  |                                 |                       |   |  |
| Work Practices  |                                 |                       |   |  |
| Recycle/ Reuse  |                                 |                       |   |  |
| Treatment Centrifuge                                  | possible local fire regulations | May not be allowed    |   | H                                      |
| Disposal  |                                 |                       |   |  |
| Contact Person:                                       |                                 |                       | Date Completed:   |  |

\*Document results in Section AE of the *Company Manual Template*.

<sup>1</sup> Include: paperwork triggered, reporting requirements, cost of controls, personal protective equipment and any other costs that may be attributed to regulations associated with using that product or process. It is not necessary to quantify on this table. See Step 8 and Appendix F for more ideas.

### Step 8: Evaluate the cost of the baseline and alternatives

Determine the cost of each alternative, including: raw materials, labor, disposal costs, (all from Step 6) and regulatory costs (from Step 7). Include all the cost categories in the baseline and the alternatives. It's important to document all costs, even those that are the same for the baseline and for the alternatives. Documenting all costs gives you a reference later to answer questions and to support further evaluations. Figure 4-a shows possible environmental costs that may be hidden in overhead in your company's accounting system. Be sure to include these hidden costs when completing the worksheets.

See Appendix F for more discussion of environmental cost accounting.

Figure 4-a. Examples of Environmental Costs Incurred by Firms\*

| <b>Potentially Hidden Costs</b>  |  |   |
|--|--|---|
| <b>Regulatory</b>  | <b>Upfront</b>   | <b>Voluntary<br/>(Beyond Compliance)</b>  |
| <ul style="list-style-type: none"> <li>• Notification</li> <li>• Reporting</li> <li>• Monitoring/testing</li> <li>• Studies/modeling</li> <li>• Remediation</li> <li>• Recordkeeping</li> <li>• Plans</li> <li>• Training</li> <li>• Inspections</li> <li>• Manifesting</li> <li>• Labeling</li> <li>• Preparedness</li> <li>• Protective equipment</li> <li>• Medical surveillance</li> <li>• Environmental Insurance</li> <li>• Financial assurance</li> <li>• Pollution control</li> <li>• Spill response</li> <li>• Stormwater management</li> <li>• Waste management</li> <li>• Taxes/fees</li> </ul> | <ul style="list-style-type: none"> <li>• Site studies</li> <li>• Site preparation</li> <li>• Permitting</li> <li>• R&amp;D</li> <li>• Engineering and procurement</li> <li>• Installation</li> </ul> <div style="border: 1px dashed black; padding: 5px; margin: 5px 0;"> <b>Conventional Costs</b> <ul style="list-style-type: none"> <li>• Capital equipment</li> <li>• Materials</li> <li>• Labor</li> <li>• Supplies</li> <li>• Utilities</li> <li>• Structures</li> <li>• Salvage value</li> </ul> </div> <p style="text-align: center;"><b>Back-End</b></p> <ul style="list-style-type: none"> <li>• Closure/decommissioning</li> <li>• Disposal of inventory</li> <li>• Post-closure care</li> <li>• Site survey</li> </ul> | <ul style="list-style-type: none"> <li>• Community relations/outreach</li> <li>• Monitoring/testing</li> <li>• Training</li> <li>• Audits</li> <li>• Qualifying suppliers</li> <li>• Reports (e.g., annual environmental reports)</li> <li>• Insurance</li> <li>• Planning</li> <li>• Feasibility studies</li> <li>• Remediation</li> <li>• Recycling</li> <li>• Environmental studies</li> <li>• R &amp; D</li> <li>• Habitat and wetland protection</li> <li>• Landscaping</li> <li>• Other environmental projects</li> <li>• Financial support to environmental groups and/or researchers</li> </ul> |
| <b>Contingent Costs</b>  |  |   |
| <ul style="list-style-type: none"> <li>• Future compliance costs</li> <li>• Penalties/fines</li> <li>• Response to future releases</li> </ul>  | <ul style="list-style-type: none"> <li>• Remediation</li> <li>• Property damage</li> <li>• Personal injury damage</li> </ul>   | <ul style="list-style-type: none"> <li>• Legal expenses</li> <li>• Natural resource damages</li> <li>• Economic loss damages</li> </ul>   |
| <b>Image and Relationship Costs</b>  |  |   |
| <ul style="list-style-type: none"> <li>• Corporate image</li> <li>• Relationship with customers</li> <li>• Relationships with investors</li> <li>• Relationship with insurers</li> </ul>   | <ul style="list-style-type: none"> <li>• Relationship with professional staff</li> <li>• Relationship with workers</li> <li>• Relationship with suppliers</li> </ul>   | <ul style="list-style-type: none"> <li>• Relationship with lenders</li> <li>• Relationship with host communities</li> <li>• Relationship with regulators</li> </ul>   |

\*Taken from "An Introduction to Environmental Accounting as a Business Management Tool: Key Concepts and Terms," EPA 742-R-95-001.

Evaluating the cost of the baseline and alternatives requires several steps, as described below.

#### Annual operating costs

Collect annual operating costs for your baseline and alternative.

Use Worksheet 4-9a to help you collect cost information. Review Worksheets 4-2 and 4-8 to assist you in evaluating environmental costs. Be as thorough as possible when considering costs, but don't worry about how you classify costs. For example, you may wish to consider personal protective equipment as a regulatory compliance cost, especially if its use is required by regulations. Alternatively, you may wish to classify all protective equipment as "materials." Use Worksheet 4-9a to record operating costs.

## Worksheet 4-9a: Annual Operating Costs

Significant Environmental Aspect: Press Cleaning

Baseline: Manual cleaning of press using a chemical press cleaner (a blend of acetone, toluene, methyl ethyl ketone, and isopropyl alcohol) and cloth wipers to wipe down the press, with no restrictions on the amount of cleaner or number of wipers used. Chemicals and soiled wipers are kept in uncovered containers during the work day and closed containers during after hours. Waste ink/solvent mixture is collected in drums and disposed of as hazardous waste. Wipers are collected and sent to laundry.

| Alternative              | Materials | Direct Labor | Utilities | Waste Management | Regulatory Compliance | Insurance | Future Liability       | Total Operating Costs |
|--------------------------|-----------|--------------|-----------|------------------|-----------------------|-----------|------------------------|-----------------------|
| Products                 |           |              |           |                  |                       |           |                        |                       |
| Blend A: Baseline        | \$24,320  | \$2,075      | n/a       | \$7,000          | \$2,100               | \$0       | possible medical suits | \$35,495              |
| Blend B                  | \$6,320   | \$2,500      |           | \$0              | \$0                   | \$0       |                        | \$8,820               |
| Technologies             |           |              |           |                  |                       |           |                        |                       |
| Work Practices           |           |              |           |                  |                       |           |                        |                       |
| Recycle/<br>Reuse        |           |              |           |                  |                       |           |                        |                       |
| Treatment:<br>Centrifuge | n/a       | \$420        | \$200     | \$6,200          | \$2,100               | \$200     | \$0                    | \$9,120               |
| Disposal                 |           |              |           |                  |                       |           |                        |                       |
| Contact person:          |           |              |           |                  | Date:                 |           |                        |                       |

## Worksheet 4-9a: Annual Operating Costs

Significant Environmental Aspect: Press Cleaning

Baseline: Manual cleaning of press using a chemical press cleaner (a blend of acetone, toluene, methyl ethyl ketone, and isopropyl alcohol) and cloth wipers to wipe down the press, with no restrictions on the amount of cleaner or number of wipers used. Chemicals and soiled wipers are kept in uncovered containers during the work day and closed containers during after hours. Waste ink/solvent mixture is collected in drums and disposed of as hazardous waste. Wipers are collected and sent to laundry.

| Alternative              | Materials | Direct Labor | Utilities | Waste Management | Regulatory Compliance | Insurance | Future Liability       | Total Operating Costs |
|--------------------------|-----------|--------------|-----------|------------------|-----------------------|-----------|------------------------|-----------------------|
| Products                 |           |              |           |                  |                       |           |                        |                       |
| Blend A: Baseline        | \$24,320  | \$2,075      | n/a       | \$7,000          | \$2,100               | \$0       | possible medical suits | \$35,495              |
| Blend B                  | \$6,320   | \$2,500      |           | \$0              | \$0                   | \$0       |                        | \$8,820               |
| Technologies             |           |              |           |                  |                       |           |                        |                       |
| Work Practices           |           |              |           |                  |                       |           |                        |                       |
| Recycle/<br>Reuse        |           |              |           |                  |                       |           |                        |                       |
| Treatment:<br>Centrifuge | n/a       | \$420        | \$200     | \$6,200          | \$2,100               | \$200     | \$0                    | \$9,120               |
| Disposal                 |           |              |           |                  |                       |           |                        |                       |
| Contact person:          |           |              |           |                  | Date:                 |           |                        |                       |

## Potential Annual Revenue Effects

Environmental projects may save you money not only by reducing your costs, but also by generating revenues. For example, an alternative may increase your product throughput because the activity takes less time to complete, or product quality may be improved enabling you to sell more of your product. The alternative may also let you recover materials previously disposed of, and generate revenues through sales of the reclaimed material (such as recovering metal scrap which can be sold to scrap dealers). These annual revenue effects should be considered using Worksheet 4-9b. If these potential revenues are difficult to quantify, you can consider them qualitatively in your evaluation by making a note in the last column of Worksheet 4-9d. In general, a reduction in materials needed would show up on Worksheet 4-9a: Annual Operating Costs. In this example, the reduction in press cleaning solvent needed due to switching to a less volatile blend (much less lost through evaporation during use) does show up in the first column of Worksheet 9-a. The revenue effects shown in Worksheet 4-9b are caused by reusing the solvent recaptured by the centrifuge for other cleaning operations (not press cleaning). In other words, the centrifuge saves on the purchase of other kinds of cleaning solvents than the ones being considered for press cleaning.

## Worksheet 4-9b: Potential Annual Revenue Effects

Significant Environmental Aspect: Press Cleaning

Baseline: Manual cleaning of press using a chemical press cleaner (a blend of acetone, toluene, methyl ethyl ketone, and isopropyl alcohol) and cloth wipers to wipe down the press, with no restrictions on the amount of cleaner or number of wipers used. Chemicals and soiled wipers are kept in uncovered containers during the work day and closed containers during after hours. Waste ink/solvent mixture is collected in drums and disposed of as hazardous waste. Wipers are collected and sent to laundry.

| Alternative     | Product Throughput | Product Quality | Reuse of or Sales of Recovered Materials | Total Revenue Effects |
|-----------------|--------------------|-----------------|--|-----------------------|
| Products:       |                    |                 |  |                       |
| Blend A or B    | none               | none            | none                                     | 0                     |
| Technologies    |                    |                 |  |                       |
| Work Practices  |                    |                 |  |                       |
| Recycle/Reuse   |                    |                 |  |                       |
| Treatment:      |                    |                 |  |                       |
| Centrifuge      | 0                  | 0               | \$34,000                                 | \$34,000              |
| Disposal        |                    |                 |  |                       |
| Contact Person: | Date:              |                 |  |                       |

### Initial Investment Costs

Collect initial investment costs for each alternative. If any of your alternatives will require an investment in new equipment, you will need to consider these costs. These not only include capital costs, but also other one-time costs accompanying your investment, such as installation costs or new equipment training. Use Worksheet 4-9c to help you collect these costs.

## Worksheet 4-9c: Initial Investment Costs\*

Significant Environmental Aspect: Press Cleaning

Baseline: Manual cleaning of press using a chemical press cleaner (a blend of acetone, toluene, methyl ethyl ketone, and isopropyl alcohol) and cloth wipers to wipe down the press, with no restrictions on the amount of cleaner or number of wipers used. Chemicals and soiled wipers are kept in uncovered containers during the work day and closed containers during after hours. Waste ink/solvent mixture is collected in drums and disposed of as hazardous waste. Wipers are collected and sent to laundry.

| Alternative           | Purchased Equipment | Utility Systems/ Connection | Planning/ Engineering | Site Preparation | Construction/ Installation | Start-up/ Training | Permitting                   | Other** | Total Inv. Costs |
|-----------------------|---------------------|-----------------------------|-----------------------|------------------|----------------------------|--------------------|------------------------------|---------|------------------|
| Products Blend A or B | none                | none                        | none                  | none             | none                       | none               | none                         | none    | none             |
| Technologies          |                     |                             |                       |                  |                            |                    |                              |         |                  |
| Work Practices        |                     |                             |                       |                  |                            |                    |                              |         |                  |
| Recycle/Reuse         |                     |                             |                       |                  |                            |                    |                              |         |                  |
| Treatment: Centrifuge | \$15,000            | 0                           | \$2,000               | \$500            | 0                          | \$200              | Depends on local regulations | 0       | \$17,700         |
| Disposal              |                     |                             |                       |                  |                            |                    |                              |         |                  |
| Contact Person:       |                     |                             |                       |                  | Date:                      |                    |                              |         |                  |

\*Typically there are no investment costs for your “business as usual” baseline.

\*\*"Other" costs potentially include land or building purchases, contingency to cover unforeseen expenses, and investment in initial inventory (also known as working capital). For further description of these costs, see Appendix F.

If a change in your processes or activities will affect your costs and savings over many years, the analysis should look at long term costs and savings. A critical component of assessing a project where costs and savings may occur over several years is incorporating the notion that the value of money changes over time – commonly called the “time value of money.” Most businesses prefer to have money sooner rather than later. If you have money today, you have the opportunity

### **L** Tip

Remember that your accountant can assist you in making these calculations.

to use it now to grow your business. See Appendix F for more information on how to obtain the net present value of your initial investments, if you wish to make that calculation.

## Cost Comparison

Use Worksheet 4-9d to list and rank the results of each cost table.

### Worksheet 4-9d: Cost Comparison of Alternatives

Significant Environmental Aspect: Press Cleaning

Baseline: Manual cleaning of press using a chemical press cleaner (a blend of acetone, toluene, methyl ethyl ketone, and isopropyl alcohol) and cloth wipers to wipe down the press, with no restrictions on the amount of cleaner or number of wipers used. Chemicals and soiled wipers are kept in uncovered containers during the work day and closed containers during after hours. Waste ink/solvent mixture is collected in drums and disposed of as hazardous waste. Wipers are collected and sent to laundry.

| Alternative     | Total Operating Costs | Total Investment Costs | Annual Revenue Effects | Rank  |
|-----------------|-----------------------|------------------------|------------------------|-------|
| Products        |                       |                        |                        |       |
| Blend A         | \$35,495              | \$0                    | \$0                    | H     |
| Blend B         | \$8,820               |                        |                        | L     |
| Technologies    |                       |                        |                        |       |
| Work Practices  |                       |                        |                        |       |
| Recycle/Reuse   |                       |                        |                        |       |
| Treatment:      | \$9,120               | \$17,700               | \$34,000               | L     |
| Centrifuge      |                       |                        |                        |       |
| Disposal        |                       |                        |                        |       |
| Contact Person: |                       |                        |                        | Date: |

Document results in Section AE of the *Company Manual Template*.

## Step 9: Evaluate Results

Use Worksheet 4-10 to compare performance, regulatory considerations, cost, and environmental effects for alternatives.

## Worksheet 4-10:\* Evaluation of Alternatives

Significant Environmental Aspect: Press Cleaning

Baseline: Manual cleaning of press using a chemical press cleaner (a blend of acetone, toluene, methyl ethyl ketone, and isopropyl alcohol) and cloth wipers to wipe down the press, with no restrictions on the amount of cleaner or number of wipers used. Chemicals and soiled wipers are kept in uncovered containers during the work day and closed containers during after hours. Waste ink/solvent mixture is collected in drums and disposed of as hazardous waste. Wipers are collected and sent to laundry.

| Alternative                                  | Performance Rank <sup>1</sup> | Regulatory Considerations Rank <sup>2</sup> | Cost Rank <sup>3</sup> | Environmental Effects <sup>4</sup> | Overall Evaluation <sup>5</sup> |
|--|-------------------------------|---|------------------------|------------------------------------|---------------------------------|
| <b>Chemical Product A (current baseline)</b> | 0                             | H   | H                      | H                                  | Poor due to effects             |
| <b>Product B</b>                             | 0                             | L   | L                      | L                                  | Good due to effects & cost      |
| Technologies                                 |                               |   |                        |                                    |                                 |
| Work Practices                               |                               |   |                        |                                    |                                 |
| Recycle/Reuse                                |                               |   |                        |                                    |                                 |
| Treatment: Centrifuge                        | "+"                           | H   | L                      | M-L                                | Good due to effects & savings   |
| Disposal                                     |                               |   |                        |                                    |                                 |
| Contact Person:                              |                               |   | Date Completed:        |                                    |                                 |

\*Document results in Section AE of the *Company Manual Template*.

<sup>1</sup> Take from Worksheet 4-7 Performance Comparison of Alternatives.

<sup>2</sup> Take from Worksheet 4-8 Regulatory Comparison of Alternatives.

<sup>3</sup> Take from Worksheet 4-9d Cost Comparison of Alternatives.

<sup>4</sup> Take from Worksheet 4-4: Criteria to Determine Environmental Impact.

<sup>5</sup> Rank the desirability of each alternative. This is a judgment call.

Note: For more information on the methodology for comparing alternatives, refer to both the DfE Website and the *Cleaner Technologies Substitutes Assessment, A Methodology Resource Guide*, DfE, U.S. EPA 744-R 95-002, Dec. 1996.

## Interpretation of Results

### Performance

The rank of “0” for product A reflects that it is the baseline. The rank of “0” for product B indicates that its performance is very similar to the baseline. The + shown for the centrifuge shows that it performs well, but is not directly comparable to the products above.

### Regulatory Considerations

Ranks show that product A has many regulations associated with the chemicals it contains, but product B chemicals have little or no regulations. The centrifuge is rated high because some states have regulations that may prohibit the use of centrifuges for recovering solvent from wipers. Also, the explosive nature of Product A ingredients would affect the type of centrifuge used. If product B were used with the centrifuge, the regulatory concern might not apply.

### Cost

The rankings show the high cost associated with using product A compared to the low cost of using product B. In addition, the low cost rank for the centrifuge reflects the cost savings affected by re-using reclaimed solvent.

### Environmental Effects

The high rank for product A reflects the serious impact of the chemicals contained in it, while the low score for product B reflects the low impact of that product’s chemicals. The M-L rank for the centrifuge reflects the reduction in use of solvent with some continuing exposure to the solvent for workers who transfer the wipers from bins to the centrifuge. There would also be some community exposure from venting the centrifuge outdoors. In addition, it reflects the concern with the possibility of explosion of the centrifuge while extracting these solvents.

## Conclusion

From both a cost and environmental perspective, switching to product B and using the centrifuge would make sense.

Remember, like all other aspects of your IEMS, evaluating SEAs and alternatives is an ongoing process. What you cannot accomplish this year, you can plan on doing next year. Take it step by step to avoid being overwhelmed.